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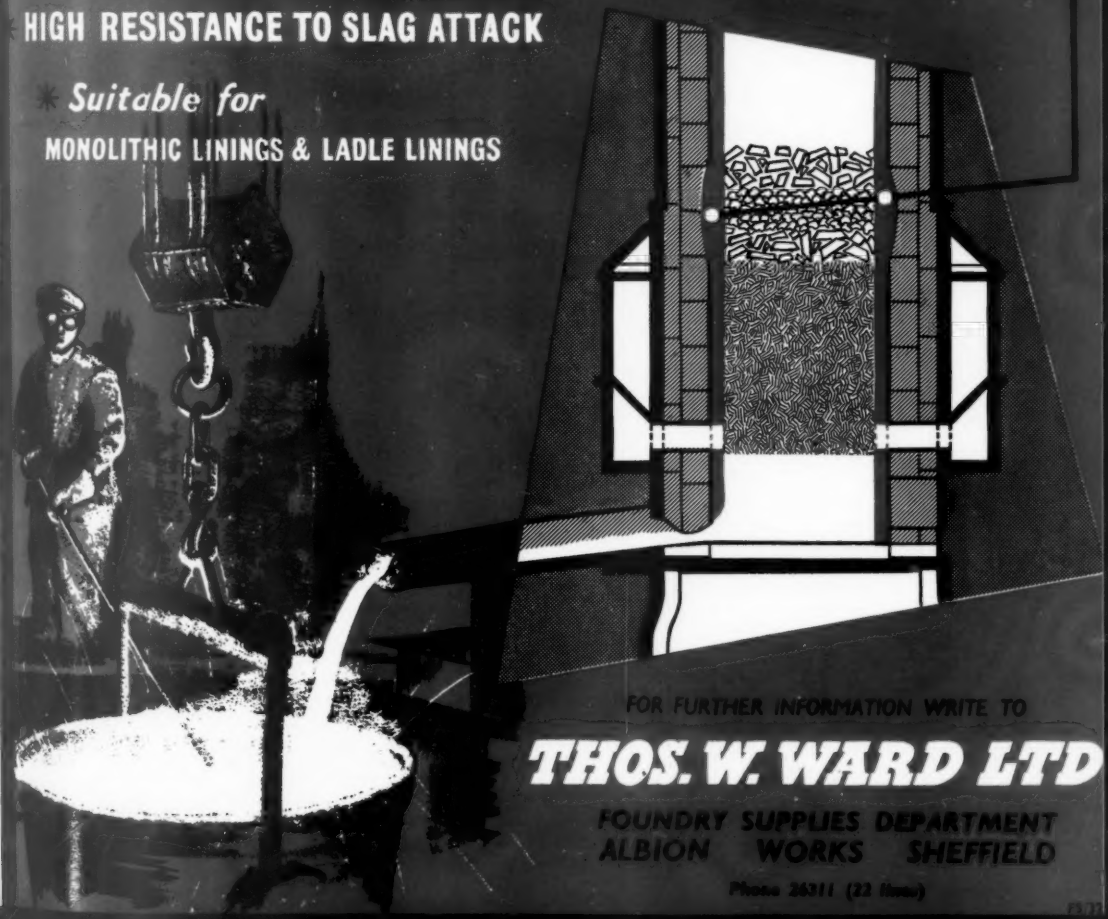

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FOUNDRY TRADE JOURNAL

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Suggested Use of Cost of Production Figures

Most brassfounders will confess that they sometimes supply castings to one of their best customers at a loss, well knowing that, on balance, their account with the same firm shows a fair margin of profit. Yet it is questionable whether it is right that the customer should be kept in ignorance of the true situation. Founders in a substantial way of business who know, or should know, the cost of every individual or at least each group of castings they make, are advised by Mr. J. L. Carter, cost consultant of the (American) Gray Iron Founders' Society, to calculate the worth of each customer. He suggests the construction of a profit-analysis table for the larger customers, showing the gross sales to them over a period, breaking them down according to the main patterns in use, and placing against each pattern the amount invoiced, the weight delivered and the price per lb. The next column in Mr. Carter's suggested table records the cost of manufacturing per lb. as ascertained by the firm's costing department, this figure being multiplied by the individual weight to give a total cost for each item. The final columns of the table represent the profit or loss in dollars and per cent.

A realistic touch is given to the specimen table by an extension for miscellaneous castings; these, though sold at a higher price to the customer, still show a loss on balance. When such items are small in number they can easily be absorbed in a large monthly account, but it is essential for them to be recognized as liabilities and their effect on the trading balance gauged. Amongst other information that analyses such as the table quoted reveal is who are the most valuable of the firm's customers; obviously they should receive the most meticulous care as to quality of inspection, good delivery, and other services.

We remarked earlier that it might be advisable to inform customers as to which are the non-profitable jobs handled for them, as they may be able to redesign the component or use an alternative material. In any case, a non-profit-making job is never desirable and if the pattern be sent to another founder who is better equipped to make it profitably at the same or even a lower price, then no damage is done to the industry—providing, and this is important, that the second founder also knows his costs and how to use them. This introduces another phase of the subject, and that is the advisability of linking the costs of production of various types, or weight ranges of castings (or any other major activity) with the selling prices, so as to acquire figures showing the lines of manufacture—regardless of customer—which ought to be encouraged or frowned upon in the production schedules.

G

DR. E. W. COLBECK, M.A., F.I.M.

Metallurgical and Research Director, Hadfields Group of Companies

Featuring . . . .

E. W. COLBECK

ERIC WINEARLS COLBECK, M.A., F.I.M., was born in London on September 5, 1899, the only son of the late E. H. Colbeck, M.D., F.R.C.P., who was a well-known heart and chest specialist. He was educated at Rugby School and on leaving in January, 1918, became an officer in the Special Brigade, Royal Engineers, going out to France with the BEF in that year. On the termination of his military service in 1920, he entered Gonville and Caius College, Cambridge, taking the Mechanical Science Tripos. He obtained honours with special distinction in engineering chemistry in 1922.

Commencing his metallurgical career as a junior scientific officer in the metallurgy department of the National Physical Laboratory under Dr. Walter Rosenhain (1922-1924), he widened his metallurgical experience when he entered the heavy steel and engineering industry by becoming technical assistant to the general manager of the Openshaw works of Sir W. G. Armstrong Whitworth & Company, Manchester (1924-1928). He took his M.A. in 1927.

In 1928, he joined the research department of the alkali division of Imperial Chemical Industries, Limited, Northwich, Cheshire, becoming chief metallurgist to this division and consulting metallurgist to several other divisions during the period 1928-1947. In 1945, he was loaned to the Department of Atomic Energy, Ministry of Supply, as metallurgical adviser to the director of research, Sir John D. Cockcroft, and the controller of production, Lord Portal. This assignment lasted until the end of 1946; during this period he was chairman of the metallurgical committee dealing with uranium metal production.

In 1947, he returned to the heavy-steel industry when he became the metallurgical and research director of the Hadfields group of companies, of which he is also the managing director of Hadfields Steels, Limited; a director of Hadfields Forgings, Limited, and Hadfields Foundry & Engineering Company, Limited. His other directorships include Millspaugh, Limited, C. A. Harnden, Limited, and William Kennedy & Sons, Limited, Canada. Mr. Colbeck, the author of numerous scientific papers on a wide variety of metallurgical subjects, was the Edward Williams lecturer at the 50th annual conference of the Institute of British Foundrymen held at Blackpool in 1953. He is a Moulton medallist of the Institution of Chemical Engineers, in respect of papers on the low-temperature properties of ferrous and non-ferrous materials, and is a founder fellow of the Institution of Metallurgists, being president of that body in 1950. He is also a past-president of both the Sheffield Metallurgical Association and the Manchester Metallurgical Society.

He is a member of a number of metallurgical committees, including the British Iron and Steel Research Association Council and the Inter-services Metallurgical Research Council, and has recently retired from the chairmanship of the BISRA metallurgy (general) divisional panel. He became a Freeman of the Cutlers Company in Hallamshire in 1951 and is a Member of the Court of both the University of Sheffield and the University of Nottingham.

Correspondence

ORIGIN OF THE WORD "PIG-IRON"

To The Editor of the FOUNDRY TRADE JOURNAL

SIR,—In the April 18 issue of the JOURNAL there appeared an article headed "Founder, Founder, Founder" by Colonel Evans. There, reference is made to the origin and meaning of the word pig-iron, in the English language. Having delved into the history of iron, I feel that I must draw your attention to an erroneous acceptance of its origin in nearly all English text books and in this case by the JOURNAL. Having had access to very old documents I became interested in the history of iron especially as I had seen some natives producing iron by very primitive methods in the bush far removed from white civilization. The following is a resumé of the origin as far as my memory serves me and from a few notes I have gathered here in South Africa from various sources.

As is well known, wrought iron was made and used thousands of years ago—about 3,800 BC references in Egypt. It was produced in a primitive air furnace as used by some primitive tribes to-day. The iron was made by heating ore and charcoal with the addition of sand and "white stone" (lime). The ore was reduced and a spongy mass formed. This was then hammered out to obtain the wrought metal. If a temperature of about 1,100 deg. C. was not exceeded then a good iron was obtained which is of course logical to those knowing the Fe-C diagram.

In 1266 the Guildhall in London was known as the Guildhalla Teutonicorum which was known to the Hanse as the *Staalhof* where they stored their iron products for sale to the English who at that time had no iron makers of any significance. *Staal* means sample. This word was later changed to the German word *stahl* or steel. Omitting many other rather interesting facts we find that this period falls into the Crusader era, when iron weapons were needed in large quantities. Some old knight on his way back from the Holy Land took along some Austrian or Styrian iron makers to help in the munition race with Islam. Styrians had been busy at the job of making iron for some time—they probably supplied Caesar with weapons to conquer Britain—and were acknowledged as being the "Big Boys" in the line. Their knowledge of English was of course somewhat shaky, and still is so to-day. They started to make iron in Staffordshire, I believe, using the old method and a *Stückofen*. There are still remnants of such furnaces in Austria, dating back to the 11th century.

Now comes the crucial matter. They were exhorted to increase production, and this meant using larger and more efficient furnaces which were critical and likely to obtain higher temperatures than desired for the sponge iron. If raw iron (*Roheisen* or then *isen*) was formed this was thrown away in disgust. It usually blocked their furnace by flowing to the bottom and solidifying there in a block. It is still known to-day as a "pig." Anyone who has a command of the German vernacular knows that the Teutons use the expression "pig" very often, denoting something dirty or spoilt, *e.g.*, "*Versaut*" derived from the word *sau* which means sow. A "pig-dog" is known as *Schweine-hund* and is often used to vent their feelings to-day. The Austro-Germans are very keen on this word to-day. When they had a bit of bad luck with their furnaces and obtained some cast-iron (raw) they used to call it *Schweine-eisen* or really *Swine-isen*. Now these founders had English assistants whom they had to instruct. These were then told what the expression meant and the word pig was used or a form using that sound—pygge or pigge or something like that. This then gave birth to the expression "pig-iron" as it is used to-day. By the way, they never used our modern casting methods which were introduced by such great metallurgists as Dudley and Darby. References are to be found in *Beck Geschichte des Eisens.*

The term *Schweine-Eisen* has long disappeared in the German language as far as general use is concerned. The term is now *roheisen*, meaning raw iron! But there is still a remnant of this terminology in the Alps in Bavaria, Tyrol and Styria where small foundries making pots and pans as well as plaques use the expression *sau-guss* meaning sow-castings—the sow being the iron that collected at the bottom of the old air furnaces in days gone by. In Massachusetts, USA, there is, or was, a foundry, called Sawguss Foundry and it was founded in 1642, when the first pot was cast in that country. Here they used the term still in use in Austria. They were probably some of the forebears of the Pennsylvania Dutch, who also arrived from Europe.

Here there is obviously a close connection again with the word pig or sow. Some old German foundrymen also use the expression *sau-eisen* if a melt is off or cold. At Leoben one can hear them using this expression as well. If the iron is really poor they also refer to it as *Schweine-Eisen* (pig-iron), but do not mean cast iron as we use it to-day.

I hope that the above remarks will prove of interest to readers and perhaps throw some light on the real origin of the term. Agricola also refers to the process and I believe there are some records in the Archives in Munich which illuminate this subject. A small reference booklet written sometime in the 18th century stated that cast iron (*Guss-Eisen*) was also known as *Sau-guss* (sow-cast) or *Schweine-eisen* and this was derived from the spoilt iron in the air furnaces centuries before they knew how to use it. Only in the late 12th century did they use it for pots, grave plates, stove plates and ornaments as well as cannon balls.

Yours etc.

[DR.] H. O. REISENER.

507, Fehrsen Street, Pretoria, South Africa.

[This letter has been abridged somewhat—Editor].

Lloyds (Burton) "Open Days"

On Thursday and Friday of last week, Lloyds (Burton), Limited, held "Open Days"—the objects of which were to mark the arrangements between Lloyds and the American Brake Shoe Company for the production of heat-, abrasion- and wear-resisting alloys and castings in ferrous metals to a high standard of precision and finish for the aircraft, tyre-making and general engineering industries. Opportunities were provided for viewing castings produced on these lines (particularly tyre moulds in high-duty iron), and inspecting the expanded facilities at Burton for the production of castings up to 20-tons weight in high-duty and spheroidal-graphite iron and both plain-carbon and alloy steels. The visitors, who included customers, competitors and trade-union representatives and the Press, were received by Mr. F. N. Lloyd and had the opportunity of meeting Mr. W. B. Given, Jnr., the chairman of the American Brake Shoe Company, Mr. R. H. Schaefer, vice-president of the American company's research centre and other members of the staff. The first day of the function finished with a dinner at the Midland Hotel, Derby, where Mr. V. C. Faulkner thanked the Burton firm, on behalf of the guests, for an instructive and enjoyable event. A total of about 180 attended on the first day and 170 on the second (guests on this day also were entertained at dinner in the evening).

Some Steelfoundry Mould and Core-sand Mixes*

By R. M. Chapman, B.Met.

This short Paper contains illustrated accounts of the Author's experiences, in his foundry, on cold-setting core-sand binders, attempting the partial substitution of Wyoming bentonite by kaolinite; the use of resin corebinders is also detailed.

Cold-setting Sands

Cold-setting sands (also known as air-hardening) are core-sands which, in the newly-mixed condition, need not have any mechanical strength whatever, because in the course of an hour or two the sand gradually hardens until eventually the core is rigid enough to be stripped from the box without losing its shape. It is then baked as for a normal oil-core.

Cold-setting sands are normally simple mixtures of clay-free silica sands with special oils; the rate of setting is generally controlled by the addition of a small amount of an accelerator, although the straight oil/sand mixture will usually set in four or five hours, depending upon the particular oil employed.

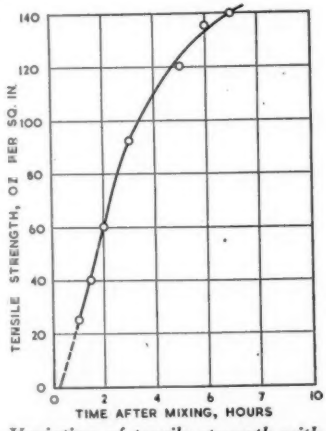
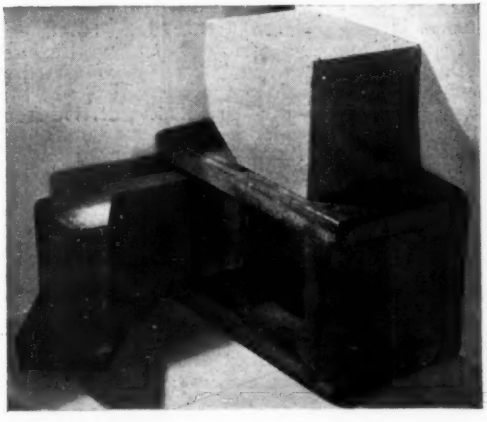


FIG. 1.—*Variation of tensile strength with standing time for a typical cold-setting sand at 20 deg. C.*

The progress of setting of a typical sand is shown in Fig. 1. The shape of the lower end (broken line) of the curve suggests that there is an incubation period before the hardening process occurs. This is fortunate, for it gives time for the sand to be inserted in the corebox before the bond develops. If the sand is used after hardening has commenced, the disruption of the bond, which has already formed, drastically reduces the strength of the finished core. In practice, the minimum induction period, which can be permitted, is governed by the time required to transport the sand from mixer to coremaking station and to produce the core; obviously it can be shorter for, say, a 50-lb. mix all used in one core than it can be for 500-lb. (about half an hour would be convenient for the latter).

Fig. 1 was determined by means of the standard AFS tensile test-piece with one sq. in. cross-sectional area and shows that the peak strength had not been reached until some 8 hr. elapsed, but experience has shown that most cores will support their own weight, without distortion, in a much shorter time, *i.e.*, at a lower-strength figure. There is one important difference, however, between such a test-piece and a practical core:—In the former the core is so shallow that it may be turned out of the corebox as soon as rammed and it will keep its shape, despite the almost non-existent strength; all the surfaces, except the one on which it rests, are thus exposed to the air from the beginning. In a production core, on the other hand, only one surface is normally exposed to the air. This condition is important, for the accessibility of air materially influences the rate of setting. It has been found that a core sand with an induction period of 20 to 30 min. reaches a mould hardness value of 80 in 1 hr., on the exposed surface, but 6-in. below this, the sand has hardly set and another hour must elapse before this region has become sufficiently rigid to retain its shape.

FIG. 2.—*Corebox and core test-specimen employed to determine the setting characteristics of air-hardening core-sand binders.*



* Paper presented at the BSCRA Conference last year, and published by kind permission of the director of the Association. The Author is senior investigator of the foundry division, K. & L. Steelfounders & Engineers, Limited, Letchworth.

Some Steelfoundry Sand Mixes

It is evident therefore that the amount of accelerator used must preserve a balance between a sufficiently long incubation period and as short as possible a total-standing time. Sand and shop temperatures also affect the setting characteristics and, for example, an oil which requires 4 per cent. of accelerator in frosty weather may require only accelerator to a fraction of 1 per cent. in heat-

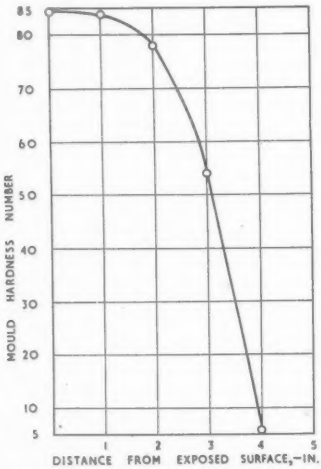


FIG. 3.—*Variation of mould hardness with distance from the exposed surface of a cold-setting sand core in a six-in. deep box, after 2 hours at 20 deg. C.*

wave conditions, in order to prevent the sand from "going-off" too soon. It is rather surprising, nevertheless, that when oils of various makes are compared one with another, it appears to be a general rule that oils which set most rapidly in depth have the longest induction period.

A simple test for setting characteristics is provided by a corebox of the type shown in Fig. 2. The progress of hardening, of the air-exposed surface, is followed by means of a mould-hardness tester. After a standard time of 2 hr., from the end of mixing, the core is turned out and hardness values determined at inch intervals down a vertical line at a fixed position from one end on the two long faces. Fig. 3 is a typical curve derived from these results, and shows how little the sand at the bottom of the box has set, even after 2 hr. The overhang is not an essential part of the test, but if there is too great a depth of unset sand, the overhang falls off.

As far as can be ascertained from published information, the oil is the usual vegetable drying-oil type which has been treated to produce an advanced stage of polymerization and to which, as in paint and varnish practice, driers such as metal naphthenates have been added. In bulk, the oils "skin" over rapidly on exposure to the air, despite this however, most of them have a considerable storage life.

Most of the accelerators consist of oxidizing agents containing the peroxide group, sodium percarbonate being a typical example, often associated with a high percentage of inert material, probably to facilitate measuring-out and dispersion in the mix.

Bentonite/Kaolinite Clay Mixes

Laboratory experiments were conducted to determine the most economic ratio of Wyoming bentonite to koalinite-type clay and the total content of this optimum ratio which was required to produce the same green and dry properties, as were obtained from bentonite alone. In the case of both dry-sands and green-sands, actual foundry mixes in current use were simulated as to composition and properties. For no other reason than that a quantity was to hand, the clay chosen was a "treated ball-clay" from Wareham, Dorset.

For the green-sand mixes Erith was the base sand, to which 4 per cent. of bentonite and 0.4 per cent. of "Kordek" were added. The latter is used in practice to stabilize the surface and edges of the moulds, should there be any tendency to air-drying before closing. It also produces a tougher mix, the shatter index being raised by some 15 points from about 80 to about 95.

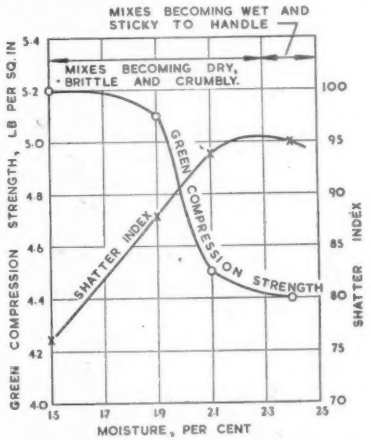


FIG. 4.—*Typical variations in green-compression strength and shatter-index figures, that occur with variations in moisture content of mixes in which Wyoming bentonite has been partially substituted with kaolinitic clay (best moisture content for working conditions is 2.3 per cent).*

The procedure adopted was as follows: At each of the three levels, 25, 50 and 75 per cent., substitution of bentonite by kaolinite clay, the total clay addition was increased, more or less by estimation and trial, until the same green properties as derived from the 4 per cent. bentonite mix were reached. In each case, the moisture content was adjusted to produce the best "temper" or moulding condition not only as judged by the feel of the sand, but as confirmed by the combination of green

compression strength and shatter index. A typical example of the way in which these two characteristics change as the moisture content is raised is shown in Fig. 4, together with remarks as to the condition of the sand.

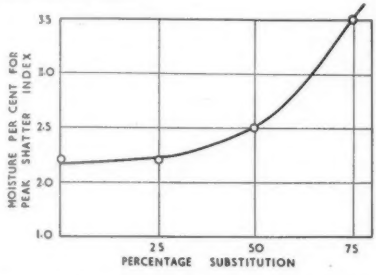


FIG. 5.—*Effect of the replacement of bentonite by ball clay on the moisture content (total clay, 4 per cent., with no Kordek).*

Fig. 3 of the Report, "Substitution of Bentonites by British Ball and Fire Clays," gives the green and dry compression strengths for various combinations of bentonite with kaolinite clay at a constant moisture content of 4 per cent. Fig. 5 of this present Report, however, shows that this is somewhat unrealistic, for even at a constant total clay content of 4 per cent., as the ratio of ball clay to bentonite increases, the amount of water required to keep the sand in the best moulding condition rises by 1 per cent. In other words, if a fixed moisture content is taken as the basis of comparison, it is possible for some mixes not to be in their best moulding condition.

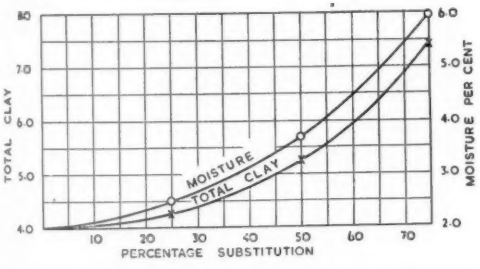


FIG. 6.—*Variation of total clay and moisture required to maintain green properties, on substituting ball clays for bentonite.*

Fig. 6 shows the total clay content required at each level of substitution and the optimum moisture associated with it. In Fig. 7, the cost of the clay per ton of mixed sand is plotted and it is evident that the cheapest combination is $\frac{2}{3}$ Wyoming bentonite to $\frac{1}{3}$ Wareham ball-clay. In the case of dry-sand mixes, the base sand was 2 parts of King's Lynn Red to 1 part of Leighton Buzzard 52, the additions being 5 per cent. Wyoming bentonite and 0.3 per cent. Kordek.

Again the question of the advisability of comparing mixes of varying bentonite:kaolinite clay ratios on the basis of a fixed moisture-content arises, but in addition, another factor must be taken into consideration. A dry-sand mould is made with sand in the green condition and the sand must, therefore, have adequate green properties. Moreover, it is a fact that the larger a dry-sand mould, the higher the green strength is required. Consequently, in deciding what degree of substitution of bentonite is possible to give a certain minimum dry strength and thence to calculate the cost of the mix, the resultant green properties yielded by such a mix cannot be ignored. For this reason, it was decided that none of the mixes prepared for the determination of dry strength values should have a green strength of less than the 7 lb. per sq. in. of the 5 per cent. bentonite mix. As before, this value was maintained in ball-clay bearing mixes by adjusting the total-clay and moisture contents. In effect, therefore, the comparison was still on the basis of green strength and the cheapest combination was equal proportions of bentonite and ball clay. Some of the dry-strength figures, unfortunately, lay beyond the range of the testing machine used, but the results obtained suggested that there was no loss of dry strength with increased substitution of bentonite. The results are shown graphically in Fig. 8. The cost of the total clay per ton of mixed sand is shown plotted against the percentage substitution of bentonite by ball-clay in dry-sand mixes in Fig. 9. In both green-sand and dry-sand mixes, the saving in the cost of clay per ton of mixed sand was 9 per cent., based on a delivered charge of £11 per ton for Wareham ball-clay.

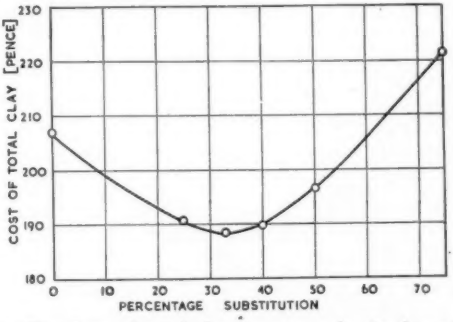


FIG. 7.—*Cost of total clay, per ton of mixed sand, at increasing substitution of ball clay for bentonite, in green-sand mixes.*

Further comparative tests are to be made with other clays but, so far, it seems that, neglecting such factors as "life," the savings to be derived from the partial replacement of bentonite by a kaolinitic clay, in practical mixes, are not so large as at first appeared.

Resin-bonded Core Sands

The use of resin core-binders has already been well publicized, Courtney's paper[2] dealing mainly

Some Steelfoundry Sand Mixes

with their application in steelfoundries. The comments here are, therefore, confined to a few points which have been found to be of special importance in the Author's foundry.

Phenol formaldehyde resins readily produce very plastic mixes, hence presumably the claim of the manufacturers that they provide " significant green strength." Though such sand mixes are doughy to the feel and have high shatter indices, they have little resistance to deformation; that is, they have low green-compression strength and cores made from them easily sag. Clay must be added to supply

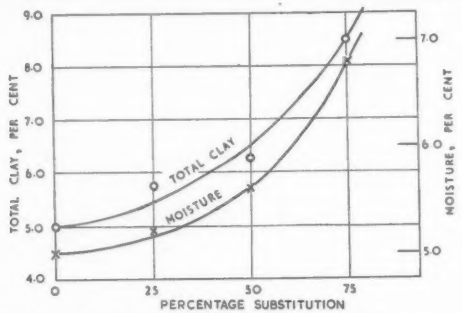


FIG. 8.—*Variation of total-clay and moisture content required to maintain green properties on the substitution of bentonite by ball clay in dry-sand mixes.*

rigidity, but this in turn destroys much of the baked strength and a proportion of cereal with its high moisture capacity must be used to restore the baked strength. Cereals, unfortunately, are also plasticizers and the formulation of resin-bonded core-sand with a reasonably high green-strength becomes a rather

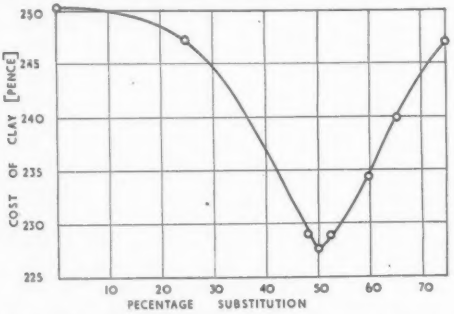


FIG. 9.—*Cost of total clay at increasing substitution of ball clay for bentonite in dry-sand mixes.*

tricky exercise in compromise. By contrast, the addition of linseed oil to a tough sand/clay/cereal mixture will rapidly reduce the plasticity.

Montmorillonite clays are far more potent in decreasing the baked strength than are the kaolinite clays and it has been found that, unless disproportionate amounts of resin are used, the cores are far too weak and friable when sufficient bentonite has been added to give the required green-strength. By using kaolinite clay, or a sand containing natural clay, satisfactory baked strength and scratch-hardness values result despite the need to use about four times as much of this clay as bentonite.

Phenolic-resin mixes are inherently sticky and such additives as paraffin must be used and the boxes painted with varnishes that will resist softening by solvents in the resin.

Resin-bonded cores appear to be much more prone to expansion troubles such as fissuring, which produces veins on the casting, than do oil-bonded cores. The addition of pelleted pitch and a change to a combination of sand, which afforded a wider grain spread, prevented both veining and scabbing.

A big advantage of resin cores is that for a given scratch hardness, the baked strength is appreciably lower than obtained with oil cores. This means that cores which have sufficient surface stability to withstand some degree of rough handling without damage need not be so strong as to give rise to the danger of hot tears. Erosion tests have shown that resin mixes are possibly slightly better than linseed-oil sands in this respect.

Resin prices have remained very stable over the last few years and with the present high price of linseed oil, the use of resin-bonded mixes enables appreciable savings to be effected.

REFERENCES

[1] *BSCRA Journal*, **19**, October, 1954.
[2] Courtney, J. " The Application of Synthetic Resin Core Binders," *BSCRA Journal*, **6**, June, 1953.

New Aluminium Company to be Formed

An agreement has been concluded by Tube Investments, Limited, with the Reynolds Metals Group of the US to combine the interests and activities of both groups in the aluminium industry in the UK. The agreement, which is subject to Treasury approval and to completion of formalities, provides for the formation of a new company to be called Reynolds Metals & TI Aluminium, Limited, which will take over the existing aluminium undertakings of TI Aluminium. The company will be owned equally by TI and Reynolds.

The chairmanship of the company will alternate between Sir Ivan Stedeford. chairman of Tube Investments, and Mr. Richard S. Reynolds, Jnr., president of the Reynolds Metals Company. Sir Ivan will be the first chairman.

TO PROVIDE for the increased requirements of industrial gases in the Glasgow area, British Oxygen Gases, Limited, has purchased a site near its present works.

A £1,200,000 ORDER for the supply of two 60-mw generating sets and equipment for power-station extensions near Durban has been awarded to the Metropolitan-Vickers Electrical Company, Limited, Manchester, a member of the Associated Electrical Industries group, by the Electricity Supply Commission of South Africa.

Tour of P. I. Castings (Altrincham), Limited

By D. H. Armitage

Mr. D. H. Armitage, director of P.I. Castings (Altrincham), Limited, was educated at Penistone Grammar School. Whilst serving his apprenticeship in the laboratories and foundries of David Brown Foundries Company, he studied metallurgy at the Sheffield University. In 1950, Mr. Armitage joined the British Steel Castings Research Association as chief development engineer. He took up his present appointment in 1953.

The reason for the presentation of this Paper under the title chosen was the fact that it had been found impossible, for a variety of reasons, to arrange a visit for members attending the European Investment Casters' Conference to an actual investment foundry. Thus, an attempt was made to "bring the works of P.I. Castings (Altrincham), Limited, to the conference" by means of an illustrated account, arranged as a tour commentary, in the hope that it would provide a substitute for the "bricks and mortar." The Paper commences with details of the development of the process as operated by the firm, followed by technological and practical considerations. The Author then describes the production methods, as practised to-day, under the following headings: operation of the process; pattern production (from the initial manufacture of the individual patterns to inspection); investment, pouring and dressing operations, and checking of the finished products.

Development

An experimental unit was laid down by P. I. Castings (Altrincham), Limited some seven years ago in order to develop a simplified and economic investment-casting process, to meet the particular demands of the general-engineering as distinct from the aircraft and aircraft-engine markets. The conception of such a process has been proved correct,

FIG. 1.—*Section of the wax room at P.I. Castings (Altrincham), Limited, where wax patterns are produced, dressed, inspected, and assembled. Pattern production machines can be seen in the background, with some completed wax assemblies in the foreground.*

FIG. 2.—*Typical wax-injection machine, the operator is removing a pattern from the die.* FIG. 3.—*Assembly of patterns on wax cylinders.* FIG. 4.—*Completed pattern assemblies; the quantity of patterns per mould vary from seven to* 700. FIG. 5.—*Batch of moulds positioned on a vibrating table; this prevents the entrapment of air-bubbles. The investment slurry is prepared in the mixer shown in the background.*

both in theory and practice, and the original experimental unit has now grown into the production unit, now in operation. This unit is now producing annually some three quarters of a million investment castings, varying in weight from 0.75 to 1,600 gm., for approximately eighty different branches or sections of the engineering industry. All castings manufactured are sold on the open market and an earlier assumption that the average quantity requirement from each die per annum would prove to be nearer 500 than the then more popular figure of 50,000, has been confirmed and substantiated with the passing of time. This comparatively low quantity of castings per die, the wide range of alloys cast and the variation in size of casting required, have demanded a plant with a "jobbing-shop atmosphere," with the necessity for complete flexibility that this wide production range demands.

Theoretical and Practical Considerations

The Picast Process, as the firm have termed their procedure, diverges from other investment techniques in certain essentials. In keeping with most investment-foundry processes, wax is used throughout to provide expendable patterns, the moulding medium, however, consists solely of a slurry of flint, with hydrolyzed ethyl silicate providing the ultimate-binding agent. The prepared investment mix, which can of course be poured, gels at atmospheric temperatures and, as previously inferred, is invested directly around the wax patterns without any intermediate "dip-coat" or "spray-coat" stages. This form of unit investment has been developed by the company to provide a satisfactory casting finish and it will be of interest to note that the spacing between adjacent castings on a cluster can be maintained within $\frac{1}{8}$-in. The view is held that any advantage that might be gained by using a duplex facing and backing investment technique is completely offset by the saving in time and cost obtained in the elimination of the spray- or dip-coating operation.

The firm's process employs centrifugal action to generate the pressure required to fill the mould

FIG. 6.—*Lowering a mould into position on a centrifugal casting machine, prior to casting.*

cavities with molten metal and this assists in inducing directional solidification radially towards the axis of rotation of the mould. In this and all other theoretical and practical considerations, the principles applying to the orthodox production of castings are regarded as applying equally in investment foundry practice. Perhaps the most important factor determining the soundness of a steel casting is that of controlled directional solidification. It has been established that the application of pressure feeding, however the pressure be generated, cannot of itself produce a sound casting. High-frequency induction melting is used exclusively by the firm and this has proved satisfactory in all respects, avoiding the danger of carbon pick-up or contamination, which attends the use of a carbon-arc type of melting unit.

Die Production

Practically all dies are machined in a free-machining material, such as cast iron, mild steel or light alloy, and little use is made of the soft-metal, cast-die technique. The essential advantages of the dies produced by orthodox machining methods, *i.e.* die sinking, arises from their long service life. Where sliding cores are used in a soft-metal die, apart from the risk of accidental damage, wear is very rapid, and flash lines develop quickly in such positions. Furthermore, a machined die can, in general, be more simply modified than a cast die. As die-production practice at the works generally follows orthodox engineering practice, it is not proposed here to deal in any greater length with this operation.

Pattern Production

As in all other investment foundries, maximum importance is attached by the firm to pattern manufacture, since in no circumstances can the finished result (*i.e.* the casting) be better than the initial pattern.

The material used for pattern production is a proprietary brand of wax and perhaps the greatest virtue that has accrued from the collective growth of the investment casting industry is the fact that reliable sources of basic raw materials are now commercially available. In the days of early development, a slight variation in the wax employed at

FIG. 7.—*Removal of ingates on an abrasive cutting-off wheel.* FIG. 8.—*Wet-belt type of abrasive machine for dressing castings. The table is fitted with a micrometer feed.* FIG. 9.—*A station on the final inspection line, where castings are checked for dimensional accuracy.*

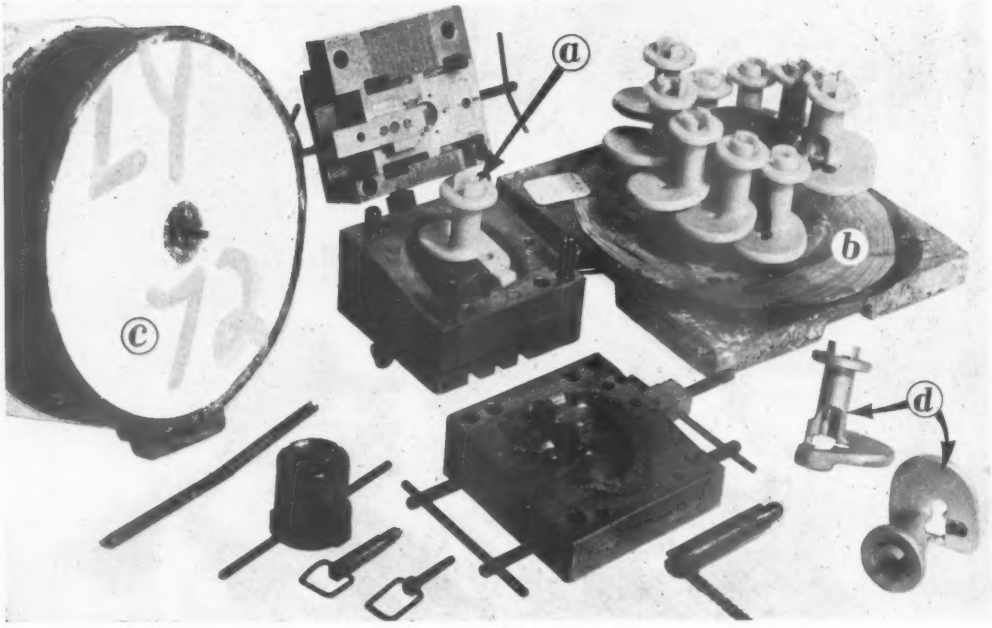


FIG. 10.—*Stages in the production of a typical precision investment casting (which replaced a welded assembly). The die components, cores and plugs are shown in the centre and the foreground, with a single wax pattern at* (a); *an assembly of patterns on a cylindrical wax centre-piece at* (*b*); *a mould in its jacket at* (c), *and sample castings at* (d).

that period, produced a material that was partially soluble in the investment mix, and the resulting casting had every appearance of suffering from a mould defect. A prolonged investigation was required to ascertain the actual cause of the fault and since that stage, acceptance tests for all wax materials purchased includes one for solubility.

Pictorial Review

A general view of a section of the wax room, where wax patterns are produced, dressed, inspected and assembled, is shown in Fig. 1. Wax-pattern production machines can be seen in the background with some of the completed assemblies in the foreground. A close-up of a wax-injection machine is shown in Fig. 2, with a die in front of the operator, for removal of the pattern. For injection, the die is located on slides on the bottom platen of the wax-injection machine, which is raised by air pressure to bring the injection orifice in the top of the die into alignment with the nozzle of the machine and to provide the clamping pressure for the die against the underside of the top platen. Wax is injected into dies with a minimum of "superheat," and the injection pressures itself can be varied up to 500 lb. per sq. in., according to the complexity of the cavity to be filled. Where heavy sections are involved, extensive use is made of wax denseners.

A very simple lesson in productivity was observed in the operation of wax machines in the early development period—the machines were operated initially with the operator standing, and when this was subsequently modified to allow the operator to sit, the output of patterns was immediately increased by some 20 per cent., due, it is presumed, to the reduction in fatigue.

After removal of the wax runner-pegs, and after inspection and gauging, patterns are assembled radially on wax cylinders as shown in Fig. 3. This type of assembly is used to facilitate the application of centrifugal pressure when the mould is poured. A group of completed assemblies is shown in Fig. 4, the quantities varying from 7 to 700 patterns per mould. All the completed assemblies shown in Fig. 4 are invested in a 10½-in. dia. moulding box or flask.

Investing and Casting

A batch of moulds is shown in position on a vibrating platform in Fig. 5, the completed assemblies having been mounted in position within the moulding boxes, and the slurry (prepared in the mixer in the background) poured directly to surround the wax patterns. In common with other investment techniques, a "head" or reservoir of refractory material is provided in excess of that

needed to surround the patterns. Wax elimination follows the removal of this head, and pre-heating of the mould to the temperature required for casting is then carried out in batch-type gas-fired furnaces. Mould temperatures between a range of 800 and 1,000 deg. C. have proved satisfactory for the majority of steel and ferrous alloys used for the firm's production. Prior to casting, the moulds are lowered into position directly upon a centrifugal casting machine, as shown in Fig. 6. When the mould is secured in position, safety covers are fitted, and the steel—or other alloy—which is melted in the high-frequency furnaces, is poured into the rotating moulds. The furnaces have quick-release contacts and can be lifted bodily for pouring purposes when the metal is at the desired casting temperature. The weight of metal melted is predetermined according to the moulds to be cast.

Dressing

After rough stripping, the remaining adherent refractory is removed from the castings by immersion in a caustic-soda solution, and is not reclaimed. This method of refractory removal has the advantage of avoiding the generation of dust. The castings are then removed from their central runner by means of a high-speed friction bandsaw or by an oxy-acetylene cutter. Then they are shotblasted and finally passed into the dressing section in a perfectly clean condition. Here, the ingates are removed on an abrasive cutting-off-wheel machine (as shown in Fig. 7) and the castings are finish-dressed on various types of abrasive-belt machine, one of which is shown in Fig. 8. This machine is of the wet-belt type; it permits very rapid stock removal, and thus is used extensively in the cleaning of ingate positions, the table being fitted with a micrometer feed. One of the final inspection benches is shown in Fig. 9, the castings being inspected individually for surface finish and gauged and tested as required.

To recapitulate and summarize essential operations in the firm's process, Fig. 10 shows various items in the production cycle of one particular component. Following the provision of the die (embodying the necessary cores and plugs shown in the lower central portion of the illustration) the sequence includes (*a*) individual wax pattern; (*b*) the assembly of wax patterns on a circular wax-cylinder and mounted on a mould base-plate, prior to investment in a unit mix; (*c*) a mould containing in its investment a cluster of castings exactly similar to the wax assembly, and (*d*) samples of the final castings.

The successful production of the part shown in Fig. 10 was brought about as a result of the procedure so often recommended in many conferences, namely, maximum liaison between the founders and the design engineer. The part was originally produced from two pieces—a forged base and a turned bar to form the stem—the two being joined by welding. From consideration of the strength requirements, in addition to securing ease of manufacture, it was decided that the part, which was required in a nitriding material, should be produced in one piece. To facilitate the production of the die equipment for this component as a casting, the technique of previous production for the part is followed, that is, a wax base is prepared to which the stem is attached by a "booking" technique.

A group of finished investment castings produced by the firm, and well illustrating the wide variety of contour and detail of which the process is capable of reproducing is shown in Fig. 11. For purposes

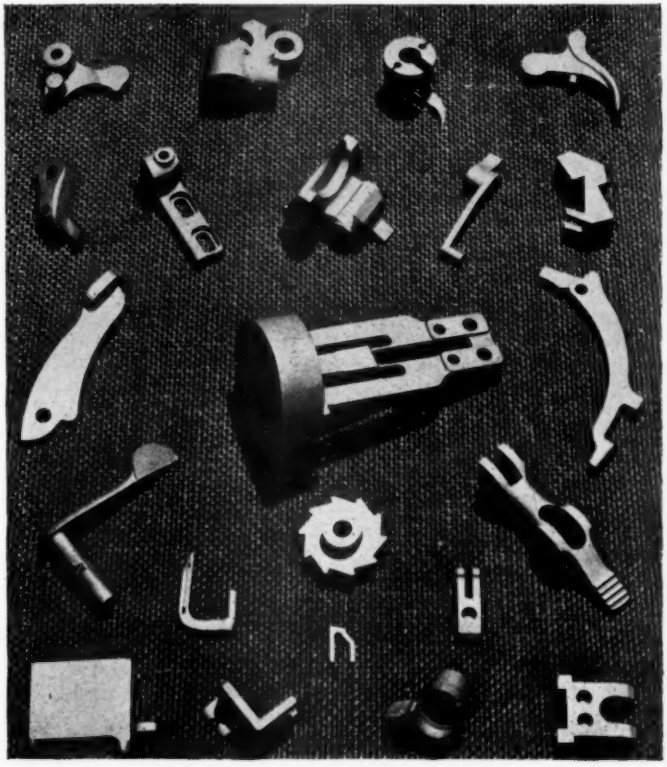


FIG. 11.—*Group of finished castings showing the wide range of contour and detail of which the Picast Process of precision investment casting is capable; the largest casting shown is 3¼ in. long.*

of size comparison, the overall length of the largest casting is 3¼-in.

Acknowledgment

The Author wishes to thank all those who have made this Paper possible. In particular, thanks are due to Mr. I. L. Gwynn who has been associated with all phases of the development of the Picast Process. Acknowledgment is also made to P.I. Castings (Altrincham), Limited for permission to publish the Paper.

DISCUSSION

THE PRESIDENT (Mr. W. H. Sulzer), in thanking Mr. Armitage for his most interesting paper, said it showed a different approach from that of the majority of firms in the way of making investment castings. He asked if it was found possible to attain a suitable surface finish on castings, the patterns for which were produced from dies made of grey iron.

MR. ARMITAGE said that while some success had been obtained with the use of grey-iron dies, at the present stage of development, light-alloy dies were preferred.

MR. H. J. MARSHALL (Nicholas Herzmark, Paris, France) asked whether it was found, when casting centrifugally, that certain speeds (revolutions per minute) suited the process particularly well.

MR. ARMITAGE said that he could only give a rough approximation, as the speeds were varied widely according to the part to be produced. Assuming a simple pattern was mounted on a feeding centre 6 in. dia., a speed of 400 rpm. had been found to be satisfactory; using the formula

$$F = \frac{MV^2}{gR},$$

and assuming unit mass, a force of 13.6*g* was obtained.

MR. LISTER asked what method was employed to ensure that air bubbles were removed from the invested assembly.

MR. ARMITAGE replied that this was achieved solely by vibration of the mould.

MR. W. J. HUMPHREYS (Deritend Precision Castings, Limited, Birmingham), having noted that no dipcoat was used, asked what was the maximum size of mould made by the process, and whether there was a tendency to segregation, within the mould, of the coarse particles.

MR. ARMITAGE replied that a normal production mould was 10½ in. dia. by 7 in. deep and throughout this depth there was no undue tendency for segregation of coarse particles.

MR. F. N. J. BALLEREAU (Ste des Forges et Ateliers du Creusot, Paris, France) enquired whether a process other than the centrifugal was used when only very few castings had to be made.

MR. ARMITAGE said his company had never tried any method of casting other than centrifugal, which was decided on initially, and they had since been busy getting the best out of that process. However, he felt that ultimately it would be a natural development that the process should be used for the normal type of pressure casting. He did not really see why this had not been done before.

Action of Centrifugal Force

A SPEAKER, recalling that the speed of rotation was stated to be about 400 rpm., asked if that speed were applied at the commencement of pouring, or whether it was the practice to pour and then to bring up the speed to the maximum.

MR. ARMITAGE replied that in his experience two of the main advantages of centrifugal casting were lost in delaying rotation of the mould until it was full of metal. He drew attention to a paper written by J. F. B. Jackson, entitled "Why Cast Steel Centrifugally?"* and from his own experience he expressed full agreement with the following statement contained therein:—

> "There is no doubt that metal entering a mould that is already rotating is immediately dispersed over a relatively large surface-area of the mould, and the resultant rate of heat abstraction, particularly during early stages of the pouring operation, is proportionately high. This ultra-rapid heat abstraction in centrifugal casting causes correspondingly rapid freezing to progress from the mould periphery radially towards the centre of rotation; *i.e.*, uni-directional freezing is promoted towards what is both a running and a feeding centre."

MR. ARMITAGE said that there were very few circumstances when he would pour into a stationary mould when operating a centrifugal casting-process.

THE SPEAKER asked if he thought there was any advantage gained by pouring into a mould revolving at (say) 150, or so, revs. per min.

MR. ARMITAGE said he did not know of any advantage in so doing.

THE SPEAKER said he was thinking of reducing the initial spread of the metal over the surface area. There was, he said, a terrific spread of the molten metal at full speed.

MR. ARMITAGE thought that this spread should be encouraged, not reduced.

THE SPEAKER commented that one wanted also to get the bulk of the metal into the mould, and to follow up with metal and not entrapped air.

MR. ARMITAGE replied that with the technique operated, and he spoke particularly of ferrous alloys, when spinning at the ultimate speed from the commencement of pouring, air pockets were never present in the finished product. Higher centrifugal force one must assume as providing pressure to displace the air from the casting cavity while the metal was solidifying.

Tolerances

MR. I. V. DI SAMBUY (Associazione de Metallurgie, Milan, Italy) asked what were the dimensional tolerances for the castings discussed.

MR. ARMITAGE remarked jocularly that he was surprised, bearing in mind the homily delivered by Mr. di Sambuy in his own Paper,† that he should have asked that question. However, all present

* *Iron Age*, Nov. 27, 1947.

† Shortly to be published.

know the stages at which dimensional variations could occur when making these castings and it was just the same in centrifugal as in pressure casting—the wax expanded on heating and contracted on cooling, and the investment expanded on heating and the steel shrunk on cooling. He thought that the reproducibility of results depended to a large extent on the degree of practical control imposed and the reproducibility of materials and practice; in other words, if one were producing the same casting to-day as yesterday using the same materials in exactly the same manner one obtained the same results.

He suggested that in his experience the casting dimensions varied more according to volume than by the more popular linear method of expression. In the case of a part, say ¼-in. thick, ¼-in. deep and 1-in. long, an overall tolerance of ±.004-in. could be maintained, but if the size of the part were increased to that of a 1-in. cube, while the overall scatter throughout the mould would be within a tolerance of ±.004-in. of a mean dimension, great difficulty would be experienced in maintaining a true mean dimension of 1-in. throughout the casting. He considered that all the generalizations which had been and were being "bandied-about" in regard to dimensional accuracy were a danger, he much preferred to give a figure for an individual part according to the volume variation in that particular part.

MR. L. TAYLOR (Deritend Precision Castings, Limited, Birmingham) asked if the author took steps to reclaim adhering refractory material.

MR. ARMITAGE replied that he did not; the whole of the adhering refractory was lost during the caustic cleaning process.

A MEMBER, on the assumption that there was small grain-size in the mould material, asked how it affected the permeability of the mould. If it did not affect the permeability he thought it was because the wax patterns were arranged near the mould wall.

MR. ARMITAGE, assuming fine-grain materials were used, said he agreed that a mould would have a low permeability.

THE MEMBER then asked what was the extent of the rejects arising from low permeability.

MR. ARMITAGE was not quite clear as to what the questioner meant. Where centrifugal casting was used instead of an inert gas-pressure feeding a stationary mould, the air within the casting cavity was taken back into the feeding section. Thus, centrifugal force was being used to provide the pressure to displace the air from the casting cavity.

[THE QUESTIONER expressed himself satisfied with this reply.]

Practical Details

MR. G. LYON (Fairey Aviation Company, Limited) congratulated Mr. Armitage on his excellent presentation of the paper and also on the fine range of illustrations. From the latter, it appeared that the centre of the cluster of castings was left solid, and he asked if that were filled with steel and what Mr. Armitage did with it afterwards. Had he planned to melt that down again, for it seemed to be a very large proportion of the weight of the whole cast?

Was it possible for Mr. Armitage to say what type of control tests he applied to the refractories and other materials used in his investment mould to withstand the centrifugal loading? Also, it seemed that he must have some good technique in cutting off so many small castings from a cluster without interfering one with another. Finally, Mr. Lyon asked whether any check was made of surface finish, and could the author express it in the usual way, in micro-inches.

MR. ARMITAGE, replying to the questions, said that the feeding centres were not normally solid; the centrifugal action produced a hollow cylinder and the amount of metal put into the mould for a given thickness of the cylinder was pre-determined according to the section it had to feed. Normally the cylinders were not re-melted in his works except in the case of semi-rare materials which could be broken up into suitable sizes for the purpose. They preferred their melts wherever possible to be produced from virgin materials.

As to the control of the investment materials, he had found in practice that there were so many potential variables that if sufficient laboratory tests were introduced to cover all aspects, then a laboratory would be required much larger than the foundry. Instead, they had profited by lessons learned in orthodox founding techniques and when a batch of new material was delivered by an established supplier, a trial mould was made, changing only the one material, and the results carefully assessed before the new material was used in production batches. That seemed to be the simplest and most effective way in which to control the mix, because there were still factors which were not fully understood.

For the removal of the castings from heavily loaded moulds, a lesson had been taken from the centrifugal casting of plain rings, both in this country and in America, and the centre was burned out. He could not quote the surface finish in terms of micro-inches, which he did not fully understand, but he submitted some samples from his production for inspection by the meeting to enable members to judge for themselves the fineness of surface finish obtained.

THE PRESIDENT asked what was the yield, *i.e.*, the weight of metal poured into the mould and the weight of castings produced per mould.

MR. ARMITAGE replied that the yield varied widely, depending whether they were making very intricate or plain castings. Therefore, the average figure, which was approximately 50 per cent. would perhaps be meaningless.

MR. LISTER, recalling the earlier statement that the air was removed from the invested moulds solely by vibration, asked if the vibration was electrical or mechanical.

MR. ARMITAGE said that electrical vibration was used.

MR. R. GREENWOOD (West Products (Metals),

Tour of P.I. Castings—Discussion

Limited, Middx), dealing with the reference in the paper to the use of oxy-acetylene cutting for the removal of some of the castings, said one of the illustrations showed an assembly which had a very large number of patterns very closely spaced. He just could not see how oxy-acetylene cutting would be applicable in that instance.

MR. ARMITAGE exhibited a sample and said that great care had to be taken in the cutting, but providing suitable fixtures were used, the centre could be removed without damage to the castings, which remained within the refractory material.

MR. N. E. TIDSWELL (W. J. Hooker, Limited) asked what was the maximum weight of metal that could be poured into one mould. Secondly, did the central pouring basin extend for any considerable distance inside the mould assembly.

MR. ARMITAGE said that he did not think that the maximum weight that could be poured into one mould had as yet been achieved, but the maximum weight to date was approximately 40 lb. The central pouring pot did not extend down into the mould but was located just above it.

MR. TAYLOR asked if the Author had had experience with producing aluminium-base castings.

MR. ARMITAGE replied that he had had very little such experience, but his foundry had made a few castings in LM6 aluminium alloy.

MR. A. DUNLOP (Foundry Services, Limited), supplementing a previous question with particular reference to the caustic-soda technique, asked how the refractories were removed when casting light alloys.

MR. ARMITAGE replied (amid laughter): "In the old-fashioned way."

MR. LISTER asked about the application of superheat when pouring the metal.

MR. ARMITAGE remarked that the question was difficult because one could not generalize; there was no answer, except that the amount of superheat varied, of course, according to the nature of the castings. In principle his firm believed in working with the minimum of superheat commensurate with the making of a good casting.

THE PRESIDENT, in thanking Mr. Armitage for his excellent contribution and his handling of the discussion, said that as a man with considerable experience of centrifugal casting, and knowing the troubles that were involved, he could perhaps appreciate the work described more than some others attending the conference.

ALTHOUGH the South African Government forbade, in March, all export of steel scrap, thousands of tons of scrap are being collected against old permits, and exported to Japan at high prices, says the *South African Mining and Engineering Journal*, July 19.

IN AGREEMENT with the Chancellor of the Exchequer, the President of the Board of Trade has appointed an independent committee to consider the suitability of the present organization and status of the Export Credits Guarantee Department for the performance of its statutory duties.

£60,000,000 Atomic-power Station

A contract has been given by the Central Electricity Authority for the construction of what is claimed will be the world's largest atomic-power station. The power station, which will cost £60,000,000, is to be built at Hinkley Point (Somerset) by the English Electric/Babcock & Wilcox/Taylor Woodrow Atomic Energy Group. It will be completed at the end of 1962. The new power station will have a guaranteed net electrical output of 500 mw.

The Hinkley Point site has been chosen in the light of future growth of electricity demand, and the station will be the first to produce electricity at a cost that is within the present average electricity generating cost. Although the station is guaranteed for 500 mw. on the contract, it will have a complete installed electrical generating capacity of 650 mw. when the additional sets, designed for use on the site, are included.

The United Steel Structural Company, Limited, a subsidiary of the United Steel Companies, Limited, is to fabricate and erect the structural steelwork for the new power station. Working in collaboration with Taylor Woodrow Construction, Limited, the company will supply between 8,000 and 9,000 tons of steelwork for the various buildings.

Marking of Imported Refractory Bricks

Changes to part of the provisions of the Merchandise Marks Order affecting the marking of imported refractory bricks, blocks, and tiles other than metallic bricks, blocks, and tiles and refractory bricks, blocks, and tiles cast from molten material, are announced by the Board of Trade.

Such goods may now be marked with an indication of origin by stencilling or painting in a contrasting colour either on each brick, block, or tile, or (when the goods are imported or subsequently sold in containers) on the outside of the container.

Representations on this matter should be made not later than October 28, to the Secretary, Merchandise Marks Standing Committee, Board of Trade, Room 1393, Horse Guards Avenue, London, S.W.1.

ECSC President Resigns

President of the High Authority of the European Coal and Steel Community since June, 1955, Mr. René Mayer, has announced his decision to resign on October 15. He will remain at his post until his successor has been chosen.

There is a possibility that Mr. Mayer wishes to be considered for the presidency of the Common Market organization and Euratom, which will start in January, and, in some quarters, opinion suggests that the existing Coal and Steel Community may be merged in the Common Market and Euratom projects.

ALTHOUGH no announcement has yet been made on the establishment of a Clean Air Council in Scotland, the Department of Health for Scotland has published memoranda on smoke control areas and the miscellaneous provisions of the Clean Air Act. At Bradford, a proposal for a 600-acre smoke control area, believed to be one of the biggest in the country, has been approved by the Minister of Housing and Local Government.

Refractory Chills — Experiments carried out at Carntyne Steel Castings, Limited*

By A. Scott

Hot-tearing has, for long, been a source of annoyance to the steel founder, and he has exercised himself considerably to overcome this defect in his product. The mechanism is well known; briefly, it is due to the concentration of stress at a location in the solidifying casting which is at a higher temperature than the remainder of the casting. A simple example is shown in Fig. 1. When a casting of this section contracts on cooling, the contraction is resisted by the sand between the flanges, and the centre rib is put in tension. The junction of the centre rib and flanges being the largest cross-section, they remain hot for a longer time and are, therefore, the weakest points during cooling. Thus, if the resistance offered by the sand is too great, hot-tearing will occur at these points.

The accepted methods of obviating the hot-tearing are (*a*) physical, and (*b*) thermal.

Physical

The physical method is the use of the tearing

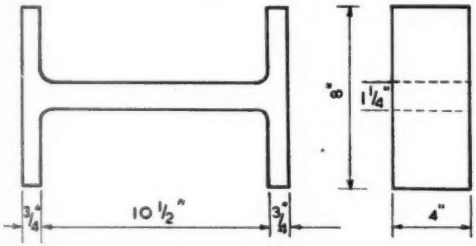


FIG. 1.—*Cross-section of a casting, liable to suffer from the defect of "hot-tearing."*

bracket, which by its rapid solidification due to its thinness, acts as a "tie" between the rib and the flanges, thereby assisting them to resist the contraction stresses. Unfortunately, uneducated customers often object to these being left on the casting and require them to be removed. Machining requirements may also make their removal necessary and even if one possesses an "Arcair" torch, expenses are involved.

Thermal

The thermal method seeks to prevent the defect by removing the heat from the troublesome area and thereby strengthening it. This may be accomplished by internal chills of the bar or horseshoe-nail type. Apart from the fact that the use of internal chills is a practice to be deprecated from the point of view of quality castings, there remains the extra time absorbed in the fettling shop in removing the unsightly marks which these leave.

The troublesome heat may also be removed by the use of external chills of the bar or plate types. These can be very effective, but also can be time absorbers in the fettling shop should they adhere to the casting.

It was to overcome the expense incurred in the fettling shop by the above methods that Carntyne Steel Castings, Limited, decided to try out external chills made of refractory material, and the chance remark by an Indian visitor put them on to chrome fines. Unfortunately, chrome ore is expensive in this country so the fines from the manufacture of chrome bricks were tried. To prove its efficiency the simple H-section shown was cast, but instead of moulding it, the part between the flanges was cored out, making the fillets at one end of the "chrome fines" (Fig. 2). In this case the chrome fines were bonded with 1 per cent, bentonite,

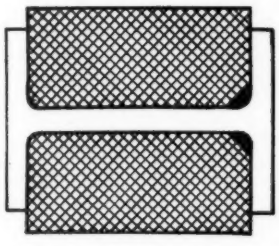


FIG. 2.—*Cores (hatched), showing the location of "chrome fines" refractory chills (solid).*

1 per cent. cereal, and 2 per cent. oil, and milled for 5 minutes; the resulting mixture was pressed into the corner of the corebox by the coremaker as he rammed up the box. To ensure even heat distribution in the casting, it was decided to bottom pour, with runners into each flange (Fig. 3).

Experimental Results

The result was very gratifying. The fillets made with chrome fines were perfect, whereas castings made with ordinary oil-sand showed pronounced hot-tears. On making a longitudinal section through the rib, it was interesting to note that a large cavity existed at the oil/sand junction, whilst only a minute pipe could be seen at the chrome-fines end.

It was then decided to adopt this method for normal production jobs, and it was found that although chilling costs rose by a small amount,

* Published by courtesy of the director of the British Steel Castings Research Association. The Author is works manager, Carntyne Steel Castings, Limited.

Refractory Chills

economy resulted in the fettling shop, removal of the chill being carried out during the normal shot-blasting operation. One class of casting which normally took a period of 3 weeks from moulding to delivery was produced in 2 weeks, from the same stage.

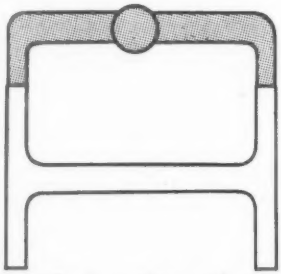


FIG. 3.—*Method of running, and position of the feeder head, used by Carntyne Steel Castings, Limited, to test the effect of refractory chills on the incidence of hot-tearing.*

There is, of course, one serious drawback to this method of chilling—it is difficult to use with core-blowers or shooters. However, this may be overcome by making the fillets, shaped or plain, in chilling sand and gumming this into a suitably shaped groove. A plain fillet-piece, and the core could be as shown in Fig. 4. The main core could, of course, be blown or shot in the normal way.

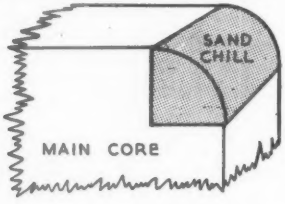


FIG. 4. — *Method of locating a refractory-chill fillet in a core section.*

Small cores are not readily handleable in the green state, and a simple method is to produce them by the CO_2 Process. By this method, intricate, as well as simple, fillet cores can be made, hardened in the box and thereafter can be handled with ease; they can then be gummed into the required position. It will be obvious that chilling sands may also be used to promote directional solidification and to chill-off small heavier-than-normal sections. Research is required, before going into production, to determine the extent of chilling required.

It will be noted that only one variety of chilling powder has been mentioned—chrome fines.* Others are also effective. Zircon and magnesite fines are very effective, but some research work will require to be done, to determine the efficacy of these and perhaps other materials, with varying degrees of chilling effect.

(*Concluded at foot of next column*)

Iron as a Charm

"Some of us couldn't abide salt, or horseshoes over a door, or mountain-ash berries, or running water, or cold iron or the sound of church bells." So Puck in Kipling's "Puck of Pook's Hill" informed the children, with whom he had made friends. This Sussex fairy, or "Pharisee" in the local dialect, was repeating what the "little people" all over Britain have always been saying, for everywhere iron or steel have been regarded as the infallible charm against the possible hurtful machinations of "fairy land."

Even to this day, in remote parts of Wales, mothers lay a poker from the hearth across the baby's cradle to prevent him being spirited away by the *tylwyth teg*, or the fairy people, and being substituted by a changling—ugly and unprepossessing. The Concise Oxford Dictionary gives for changling—"Thing or child substituted for another by stealth especially elfchild thus left by fairies."

In his "The Golden Bough," Frazer says that in the Highlands of Scotland the unfailing charm against the "elfin-people" is a sword, a knife, a gun barrel or a scythe. If a person entered a fairy house he was advised to plant a knife, a needle or a fish hook in the door so as to prevent the elves from closing it and imprison him for ever. Iron and steel are often taboo in many of the religious rites of primitive peoples, and stone knives are usually employed for such sacred purposes. The Druids of ancient Britain usually cut the ritual mistletoe from oak trees with a golden knife. It is recorded that, in the earlier part of the century, colliers in South Wales wore iron rings upon their fingers as charms against *Pwcca'r Trwyn* (Puck of the long nose), the mischievous fairy of the coal mine. Many were the tales told of his exploits, but against his malevolence the iron ring was an infallible charm.

But why this belief in iron as a charm? First, as Frazer says, there is the persistence of earlier forms like flint knives in relation to the more ritualistic events, but there is more to it than this. When iron-using Celts came to Britain they found much of it inhabited by small, dark, Mediterranean-type people who were still largely in the Stone and Bronze Age phases of their culture, so that their weapons were no match for the axes and swords of the invaders. The natives dispersed to caves in the hills and left the rich plains to the Celts. Thus to them iron and steel became the irresistible things; hence arose the stories of elves who lived underground. "Fairy gold there was but never fairy iron for a reason plain to see."

* The percentage composition of the chrome fines and magnesite fines used are:

CHROME FINES.

Cr_2O_3	MgO	Fe_2O_3	SiO_2	Al_2O_3	CaO	MnO	TiO_2
36/40	13/20	12/15	4/6	16/20	1/2	0.2	0.2

MAGNESITE FINES.

MgO	Fe_2O_3	SiO_2	TiO_2	Al_2O_3	CaO
85/90	2/5	2/3	0.2	1/3	1/2

News from South Africa

Guards Vans

The Gloucester Railway Carriage and Wagon Company, Limited, have won a further order to supply 30 goods train guards-vans to Rhodesia Railways. This order, valued at £100,000, follows the recent award of a contract to the same firm for 74 coaches of various types for Rhodesia Railways. The guards vans will be similar to a number built by the British firm for Rhodesia since the last war and will be largely of timber construction with steel framing.

Bus Fleet

The South African Railways and Harbours Administration has ordered a fleet of 20 British-built Albion 61-passenger buses for its country road service from Albion Motors, Limited. The 200-h.p. chassis to be provided has been designed especially for "moderate-to-severe" secondary roads.

Iscor's Expansion

During the financial year 1955-56, South African Iron and Steel Industrial Corporation produced 1,465,000 tons of ingots, and the intention is to increase this amount to a production rate of 2,000,000 tons, though even then South Africa will probably need to import some steel supplies from overseas. It is estimated that the cost of the intended expansion in the Transvaal will be almost £33,000,000, and the capacities of Iscor and Vanderbijlpark works will be increased.

Diesel Buses for Rand

Johannesburg is to have the largest trolley- and diesel-buses in the world. The chassis for 10 buses and 40 trolley-buses are being built as part of a £300,000 order for vehicles for the city's transport department. These chassis are being built in Wolverhampton, Staffordshire, England, and the bodies will be made and fitted locally.

Airfield in April

Kariba is to have a permanent airfield, and it is hoped it will be ready by next April. The contract is worth about £143,000, and the Federal Power Board have awarded it to John Laing & Son, Limited.

Copperbelt in South Africa?

Unconfirmed reports point to disclosures of a major copperbelt having been located in the territory. It is understood that Lorelei Copper Mines, Limited, which has already proved copper-molybdenum ore reserves to the extent of about 20,000,000 tons and is conducting small-scale productive operations, are the subject of negotiations for an exchange of control. The S. African Minerals Corporation, Limited, which is expanding output of manganese ore from its South-West African deposits and is conducting an intensive programme of exploration for extensions to these deposits, has had encouraging disclosures of other minerals as well. Unconfirmed reports state that these minerals include phosphate, vanadium and radioactive material.

Vanadium Mill for Transvaal

Two American firms, the Rockefeller Centre Inc., of New York and the Minerals Engineering Company of Grand Junction, Colorado, together with an English firm, High Speed Alloys, Limited, of Lancashire, are building a vanadium mill in the Transvaal. It is reported that the mill will have an annual output of 3.6 million lb. of vanadium concentrate. The plant is being financed by Rockefeller Centre Inc., and High Speed Alloys, Limited. It is to be erected by the Minerals Engineering Company (South Africa) Limited, in which the above firms have joint shares, and is expected to be in operation in September of this year.

Cronite refused Extension

Cronite Foundry Company, Limited, has lost its appeal against the decision of Somerset County Council not to allow the extension of its existing factory premises at Frome. The Minister of Housing and Local Government says that the neighbourhood in which the foundry is situated is residential or agricultural and in his view any such major extension would be out of keeping with the surroundings. Having considered the effect on the economy of Frome if the firm moved to a site elsewhere rather than to another site in Frome, the Minister adds that it does not appear to him that the effect is likely to be so serious as to warrant allowing the permanent establishment of a large foundry to the detriment of nearby residences. Accordingly, he has decided to dismiss the appeal.

At the time of the inquiry it was stated that the firm might ultimately move to alternative sites either at Crewkerne or Trowbridge if they were unable to expand at Frome.

Film Festival

A "Festival of Films in the Service of Industry" is to be held at Harrogate from October 8 to 12, where the official opening ceremony, on October 9, will be performed by the Rt. Hon. Lord Mancroft, M.B.E., T.D. Films to be shown include those dealing with careers in industry; public and human relations; productivity; technical education; health and safety; job training, etc. Foreign and non-competitive films also have a place in the programme; special events have been arranged for ladies attending the Festival. The events will conclude with a dinner and the presentation of awards. Those wishing for further details should apply to the organizing secretary of the "Festival," at 3, Portman Chambers, 7-9, Baker Street, London, W.1.

High Rate of Industrial Accidents

Out of 3,399 casualties treated at Sheffield Royal Hospital during a recent month, 1,294, or 38 per cent., had been injured in accidents at works, said Alderman A. Ballard, Lord Mayor of Sheffield, at the annual dinner of the Sheffield Area Industrial Group of the Royal Society for the Prevention of Accidents.

Sir Peter Roberts, MP, the Master Cutler, said that between 180,000 and 200,000 employees per year were off work for three or more days through accidents, and though tremendous efforts were being made to reduce the number, still greater efforts were needed. In America the accident frequency rate per million hours worked was 7.2 per cent., but in this country it was 32.6 per cent.

National Management Conference

The British Institute of Management, 80, Fetter Lane, London, E.C.4, announce that the annual convention is to be held in Bournemouth from November 6 to 8. The theme is to be "Speeding the Application of Research." The opening address is to be given by Viscount Monckton of Brenchley. Dr. J. G. Pearce, O.B.E., director of the British Cast Iron Research Association, is presenting a paper at a session over which Mr. F. W. Rowe is to preside.

Details of the meeting are to be had from the secretary of the Institute, at the above address.

Notes from the Branches

South Africa

A works visit to the factory of African Explosives and Chemical Industries, in the Johannesburg area, was arranged for a party of members and guests of the South African branch of the Institute of British Foundrymen on the afternoon of August 14. The factory, with a total production of 250 tons per day, is claimed to be the largest producer of dynamite in the world. The works extend over an area of 15 sq. miles and 6,000 people are employed.

After partaking of refreshments, the party was issued with white dust coats and taken first to the ammonia plant. Although it is only four years ago that £6,000,000 was spent on improvements to this plant, a further £10,000,000 extension programme is now under way. The party was next conducted over the tube-drawing plant—responsible for the production of 500,000 detonator tubes per day; the tubes being drawn in a manganese/aluminium or copper material. The last department to be visited was the central engineering workshops, which are responsible for maintenance of all equipment in the works and also for a certain amount of research and development work.

The party then returned to the main offices by bus, where Mr. Pienaar, the branch president, proposed a hearty vote of thanks to the management of the company for their courtesy in arranging the visit. He also commented on the variety and standard of the castings used in the various departments, and said that the South African foundryman could be proud of the fact that he was able to produce castings which met the standards required for this type of work.

Lecture

" Injection of Swarf into the Cupola " was the title of the lecture given by Mr. S. H. Chrobok, DIP. ING., chief metallurgist, African Malleable Foundries, Benoni, to the branch on Thursday, August 22. The meeting was held in the National Cash Register Auditorium, Johannesburg, with Mr. Pienaar in the chair.

The Author illustrated, and gave details of, two types of swarf injectors—one employing compressed air and the other having a pneumatically-operated feed-ram. He explained how the swarf was injected direct, without previous preparation, into the melting zone of the cupola, where no free oxygen existed and where rapid melting prevented any oxidation or ejection by the blast. He quoted the results obtained from two independent foundries—with an addition of 27 per cent. swarf, one showed a melting-loss figure of 3.4 per cent. and the other 4 per cent. " In practice," said Mr. Chrobok, " one ton of swarf will replace about ¼ ton of pig-iron and ¼ ton of steel." He also stated that successful additions of swarf had been made of up to 30 per cent. of the metal charge during normal melting and even 100 per cent. had been added for the last hour of a melt. In the latter case, the metal was desulphurized in the ladle with 1.5 per cent. granulated soda-ash, and pigs were cast which were later used in the normal metal charge. In order to preserve the lining bricks, the blast had to be reduced 50 per cent. and melting of 100 per cent. swarf should be limited to one hour towards the end of the heat.

After discussing swarf delivery rates, its particle size and a number of metallurgical factors, the Author went on to say that swarf could be successfully utilized in a cupola by using an injector specially designed for this purpose. He said that in his opinion the savings thus made would fully justify the initial expense of the equipment, and made the following points: The chemical, thermo-chemical or metallurgical reactions were unaffected by the swarf addition and the properties of metal produced when using up to 25 per cent. swarf addition were not in any way inferior to those of metal obtained by using cupola charges of solid metal only. Furthermore, the process was equally adaptable to the water-cooled or hot-blast cupolas. It had been proved that metal temperature remained about the same as usual and that no ejection of swarf or oxidation took place under normal melting conditions. Any expensive alloying elements added to cast metal and normally lost in the swarf, could be reclaimed by injecting the alloyed swarf back into the cupola. Replacements of bought scrap by swarf of known chemical composition gave stricter control over the chemical composition obtained. Mr. Chrobok concluded by saying that the foundryman now had at his disposal a method of melting swarf in the cupola successfully and simply, with full metal recovery.

Discussion

Mr. A. P. Alexander opened the discussion by quoting his own experiences in the recovery of some 20 tons per month of swarf derived from his machine-shop. After experimenting with briquetting, electric melting and open-hearth melting, he had found that the most economical and practical method of utilizing the swarf was by direct recovery in the cupola, employing the following method: The swarf was taken direct from the machine-shop and the coolant drained off, whereupon the swarf was mixed immediately with 15 per cent. by weight of powdered lime to absorb the moisture, inhibit excessive oxidation and to slag the melt to the correct degree. The swarf was then placed in a 7-ply paper-bag and suitably sealed. Swarf mixed in this manner constituted 20 per cent. of the cupola charge at his works.

After further interesting discussion, Mr. G. H. Ford concluded the meeting by congratulating Mr. Chrobok on his excellent and thought-provoking paper, and, on behalf of the branch, proposed a hearty vote of thanks to him.

Law Case

Drill Not Properly Earthed

A portable drill which was not properly earthed led to the electrocution of a workman at the works of Cochran & Company, Annan, Limited, it was stated at Dumfries Sheriff Court. The company was fined £10.

A Factories Inspector, Miss Winifred Irving, said that Mr. Joseph Dalrymple, a light plate worker, was drilling holes in the bracket of a large accumulator.

Mr. Dalrymple was standing on a wet floor with the drill pressed into his chest when he fell to the ground, dead. Two other men received slight shocks while the drill was being disconnected. " If the drill had been properly maintained," said Miss Irving, " the voltage would not have reached such a dangerous level."

Water had accumulated in a recess in the drill and penetrated the casing, the earth wiring was broken at the socket, and the extension lead was not firmly fastened, rendering the whole system of earthing useless.

For the company it was stated that every electric drill was inspected three times a year by qualified men. Mr. Dalrymple's drill had last been inspected in February. The company had now taken the precaution of stepping down the voltage to prevent such an accident in future.

Company News

SAMUEL SMITH & SONS, LIMITED, ironfounders, etc., of Smethwick—The dividend for the year ended June 30, 1957, is maintained at 20 per cent. Profit of the parent company was £26,346 (£34,798), subject to tax of £13,979 (£17,543).

POWER-GAS CORPORATION, LIMITED—An interim of 5 per cent. for the year to September 30, 1957, on £1,400,000 capital as increased by last year's rights issue, has been declared. Previously, single yearly payments have been made, that for 1955-56 being 14 per cent. on £1,000,000.

JOHN DALE, LIMITED, founders, collapsible tube manufacturers, etc., of London, N.11—The company's offer for the common shares of Modern Containers, Limited, Toronto, has been accepted. Mr. W. E. H. Jones, managing director of John Dale, and Mr. J. W. G. Collins, finance director, have gone to Canada to complete take-over arrangements.

WILLIAM JACKS & COMPANY, LIMITED, metal merchants and engineers, of London, E.C.2—The company has obtained CIC permission to capitalize part of the general reserve. The directors intend to issue to ordinary shareholders, as soon as practicable, one ordinary share for every two held. The issue would involve an increase in authorized capital.

JAMES BOOTH & COMPANY, LIMITED, non-ferrous metal manufacturers, of Birmingham—The offer of the Delta Metal Company, Limited, to acquire the whole of the ordinary shares of the company on the basis of two Delta Metal 5s. shares for every one James Booth £1 share has been accepted by over 95 per cent. and has therefore become unconditional. The final date of acceptance has been extended to October 20; holdings still outstanding at that date will be acquired under the provisions of Section 209 of the Companies Act, 1948.

NEEPSEND STEEL & TOOL CORPORATION, LIMITED—The distribution is maintained at 50 per cent. for the year to March 31, 1957, on ordinary capital increased by a one-for-four free scrip issue, an effective rise of 10 per cent. in the year's distribution. Group trading profits expanded from £1,030,926 to £1,334,118, and, after heavier taxation, the net balance is up from £527,774 to £655,575. The final ordinary dividend is 37½ per cent.—the 1955-56 total on the smaller capital included a 30 per cent. bonus, but holders were told at the last annual meeting that bonuses were to be discontinued and would be consolidated in the dividend in future. Holders of the £31,150 6 per cent. participating preference capital again receive their maximum 10 per cent. entitlement.

VILLIERS ENGINEERING COMPANY, LIMITED—Underwriting has commenced of an issue of £600,000 6 per cent. convertible debenture stock 1972-77. The stock is offered for subscription at £98 10s. per cent. to ordinary stockholders registered on August 31. The issue will repay a temporary £600,000 bank loan arranged to finance the acquisition of the ordinary capital of J. A. Prestwich Industries, Limited. At the recent extra-ordinary meeting a resolution to increase the capital to £1,750,000, to capitalize £125,000 of reserves, and to issue one new ordinary share for every four held, was approved. Mr. L. Farrer, the chairman, announced that the resolution having been passed, the offer to acquire the whole of the issued ordinary capital of J. A Prestwich Industries became unconditional and binding. Acceptances have been received from holders of just over 97 per cent. of the ordinary capital.

New Capital for Vokes

Arrangements have been made by the directors of Vokes, Limited, filtration and silencing engineers, of Guildford (Surrey), to place £320,000 7 per cent. debenture stock 1977-82 at 98. To the extent of £70,000 the stock will be issued in substitution for the existing 5½ per cent. debenture.

Proceeds of the balance of the stock will be applied towards the purchase of not less than 90 per cent. of the total issued share capital of J. E. Hanger & Company, Limited, artificial limbmakers, of London, S.W.15. Further details of the acquisition will be contained in the directors' report and accounts for the year ended June 30, 1957, which will be circulated to members in November.

From the preliminary figures of the group the directors are satisfied that the consolidated net profit for the year will compare favourably with the previous year.

Modern Engineering Expansion

Following the sale in the latter part of 1955 of the machine-tool interests to the Gas Purification & Chemical Company, Limited, Modern Engineering Machine Tools, Limited, acquired Linley Engineering, Limited, Dema Glass, Limited, Links Glass, Limited, and H. C. Shepherd & Company, Limited. The company, formerly Modern Machine Tools, Limited, already owned Daventry Engineering, Limited.

Total consolidated assets at December 31, 1956, amounted to £982,350, the previous figure at December 31, 1955, amounting to £409,925. Group trading profits amounted to £158,914 for the 15 months to March 31 last, against £58,156 for the previous year, and the net profit was £54,669 (£21,546). The dividend is 30 (10) per cent.

New Export Map

Help for the United Kingdom trader in overseas markets is the keynote of a wall map of the world which the Board of Trade are issuing to exporters and manufacturers. The map, entitled "Information for the British Exporter," measures 40 by 30 in. and pinpoints every overseas territory where a commercial representative of H.M. Government is normally stationed ready to help any United Kingdom trader to increase his exports. Coloured according to currency areas, the map gives comparative world times, £ equivalents and figures of recent two-way trade between principal markets and the United Kingdom together with other information of value to the exporter. Distribution of the map, which is designed to publicize the Government's services to overseas traders, will be made by the Board's Regional Offices and will be limited to exporters and potential exporters.

Fuel Saving Charts

A revised edition of "Fuel Saving Charts," by Walter Goldstern, has just been published by John D. Troup, Limited, 90, High Holborn, London, W.C.1 (10s. post free). Originally published in the *Steam Engineer* some 18 years ago, the charts were subsequently reprinted in booklet form. Five years ago a new volume, containing 24 charts, was published. The charts have been brought up to date for this new edition and some new charts are included. They are designed to enable operating engineers to supervise the operation of steam and boiler plant by carrying out calculations without resorting to data and formulæ which may not be readily available.

Book Review

La Fonderie d'Aluminium en Sable et en Coquille, Sand- and Die-casting Aluminium Foundry Practice (in French), by R. Irmann. Published by Dunod, 92, Rue Bonaparte, Paris, 6; price 3,900 French francs.

This short guide to the art of aluminium casting by Dr. R. Irmann, which has a well deserved reputation in Germany and Switzerland, has now been published in a careful French translation. A preface by Mr. R. Gadeau, director of the *Centre Technique de l'Aluminium* (an organization combining to some extent the functions of two British organizations: the Aluminium Development Association and the British Non-Ferrous Metals Research Association as far as aluminium is concerned), warmly recommends the book to the technical students and practical foundrymen.

In the first chapter (20 pages) a very brief account is given of the raw materials and the processes used in making aluminium foundry alloys, including the composition of virgin aluminium and of the most important types of foundry alloys. Chapter 2 is in effect an account of the metallurgy of the casting process in 20 pages—containing of course only a selection of the simplest and most important aspects. About 40 pages are devoted to the discussion of melting furnaces and melting procedure, 12 pages to fluxes and fluxing procedure, and 25 pages to the discussion of the influence of composition on mechanical and foundry properties.

Chapters 6 and 7 describe in 90 pages the practice of aluminium sand casting and permanent-mould casting (in this country termed gravity-die-casting). Chapters 8 to 10 deal with fettling, repairs of defects by welding, soldering, impregnation and with heat-treatment. The various methods of testing castings, including non-destructive methods, are described in chapter 11, while chapter 12 gives an account of the principles of good design as applied to aluminium castings, with many instructive drawings. Tables on foundry defects, standardized alloys and their properties, and a bibliography conclude the book.

The intention of the author, clearly stated in his introduction, is to serve the practical founder, especially in the smaller foundry when starting work on aluminium castings. The book is therefore written in simple terms, and highly technical language and involved problems are avoided as far as possible. So far as the practical chapters on melting and casting practice are concerned, they are certainly very suitable indeed for the purpose envisaged. The information offered is sound, based as it is on the experience of the well-known industrial research laboratory, of which the author was a leading member for many years, and illustrated by beautiful and clear graphs and pictures.

When dealing with the more theoretical parts on the metallurgy of aluminium alloys and on the influence of composition and heat-treatment, the great difficulty of describing these subjects in simple terms as well as very briefly, has sometimes led to over-simplification, and sometimes to the inclusion of information somewhat above the level of understanding of the reader envisaged.

The fact that Dr. Irmann has not fully succeeded where so many others before him failed, cannot however be held against the book as a whole. It is a very useful and sound introduction for the aluminium founder to be, and also of considerable interest to the practitioner of the art.

E. SCHEUER.

New Catalogues

Furnace Hood for Electric Melting Furnaces. In publication R.5607, Air Control Installations, Limited, Ruislip, Middlesex, describe and illustrate a furnace hood for electric furnaces which not only collects the dust and fumes as they are generated but passes them through a hydrostatic dust collector before passing to the outside atmosphere From supporting literature, it seems that the original tests were made in Los Angeles, where, owing to the conformation of the countryside, the requirements for "clean air" assume greater importance than in most other areas. Also included with the above were a catalogue and a reprint from the American Foundrymen's Society's publication covering cupola dust control. Recent correspondence in this JOURNAL lends importance to the study of what is available for the prevention of dust and fume from electric furnaces, and interested readers should write to Ruislip for copies of the material the company supplies covering this question.

Greek Bentonite. An interesting pamphlet has been received from British & Overseas Minerals, Limited, Creechurch House, Creechurch Lane, London, E.C.3. It covers two types of bentonite, one called Grecobond —a sodium-type, and Diabond—a calcium-type. The properties of these two brands are compared with well-known and competitive materials and, in one case, the reviewer thinks there has been a lack of good taste, in printing the trade name of competitive clay instead of its generic title. As the material described in the pamphlet comes from the island of Milos, it was a happy thought to decorate the front of the pamphlet with a picture of the Louvre statue of Venus of Milo.

Shell-moulded Castings. Brockmoor Foundry Company, Limited, Brierley Hill, Staffs, have issued an eight-page illustrated leaflet devoted entirely to promoting the sales of shell-moulded castings. By captioning a series of pictures, the complete cycle of manufacturing operations is disclosed. This takes up three pages; the sixth and seventh pages are devoted to a series of questions and answers likely to interest the buyer. The final page illustrates a good-looking heat-treatment shop. The reviewer suggests that through re-arrangement the blank inside front cover page could have been used to illustrate a range of castings the firm has made.

House Organs

Close-up. No. 7; issued by Armstrong Whitworth (Metal Industries) Limited, and Jarrow Metal Industries, Limited, Close Works, Gateshead, 8.

Naturally this issue records the knighthood conferred upon Sir William Scott, the managing director. There are accounts of two sales conferences, one held in Sheffield and one—on roll design—at Close Works, the latter being attended by 25 delegates from all over the country. An interesting article covers the making and properties of refined iron.

Newsletter, Vol. 9, No. 8; issued by the David Brown group of companies.

This issue reports the success, for the second year running, of the foundry section in the annual gala, as the staff from this section won both the David Brown and the directors' cups. There is an illustrated description of the reorganization of the firm's tractor division. Finally, there is a report of the retirement of Mr. H. L. Ritson who, since 1924, has been the Midlands representative of the group.

Publications Received

Accidents, Vol. 32. Published for the Ministry of Labour and National Service by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2; price 1s. 3d. net.

This issue describes three foundry accidents—two of which were fatal and, happily, the third was a "near miss." Of the fatal accidents, the first was due to a geared 15-cwt. ladle trunnion fracturing at its junction with a checkplate. Welding had been carried out, giving a coarsened and weak structure, but there was also a crack which extended over half the cross-sectional area. This accident stresses the need for a periodic examination of ladles, and that means not merely the gearbox but the whole construction. The second occurred when stripping a heavy roll which was bottom run, the runner being carried in a series of stacked moulding boxes. The casting was laid on the floor and whilst clearing the neck boxes, the vibration caused the runner, still carrying some moulding boxes, to fracture with fatal results to the operator. Safer methods have now been introduced.

The third, but non-fatal, occurrence was in connection with a sand mill. A scraper was showing some defect and the attendant, doing as he should, safely switched off the current and locked up the switch. The fitter, after inspecting the job, went for his kit of tools and entered the mill. The attendant, unaware of the fact that the fitter had returned and was inside the mill, thought it would give easier access for his mate if he moved the rollers half a revolution, to give a clear space near the ladder. Fortunately, the fitter managed to edge himself out of the way and no damage was done. Moral: a man inside the mill should have the switch key with him! Other accidents reported in this publication as occurring in other industries, are of the type which may happen in or around foundries also, so this bulletin is worth examining from cover to cover.

Kodak Negative Materials for Professional, Commercial and Industrial Photography, issued by Kodak, Limited, Kingsway, London, W.C.2

This 15-page booklet details the salient features of the sheet and roll film plates, and 16-mm. cine films which the firm produces for serious photographers. The characteristics of each type of sensitized material are well set out and it is pleasing to realize what a broad basis for selection is provided. The sole criticism the reviewer makes is not about the book itself, but about the lack of uniformity of the titles of the materials offered. Nowadays, people "in the know" invariably order by code letters and it is suggested that these should figure first in all the names of the materials. As for the names themselves, one is left to wonder what will extend the range of "super super" and "three-star" type of adjective when another new line appears. However, the information given in the booklet does show what is available to meet the varied requirements of photography nowadays. To supplement this publication, data sheets are offered giving technical information about each of the materials listed.

Coke-burning Appliances, 5th edition. Published by the Gas Council, 1, Grosvenor Place, London, S.W.1; price 15s.

This book has been published at a particularly appropriate time as no fewer than 240 local authorities have so far scheduled smokeless zones. It is an excellent compilation as it illustrates, by pictures and line drawings, the large number of approved designs of domestic open-fire grates, heating stoves, domestic boilers, central-heating boilers and cookers available on the market. In addition much technical data—strictly comparable between different types—are given on each model. The book has had the co-operation of the makers of the equipment in its compilation, and the reliability of the figures quoted can thus be assumed to be unimpeachable. Whilst the makers of this class of goods will automatically be provided with a copy of the book, other foundry owners would do well to procure it, as, like most people, in general they are faced with the problem of ensuring comfort in the home at an economical price.

Who Owns the Steel Industry? Published by the British Iron and Steel Federation, Steel House, Tothill Street, London, S.W.1.

The reviewer once attended a political meeting covering the proposed change-over of the iron and steel industry from private enterprise to a State monopoly, and the main speaker invariably referred to the owners as the Steel barons. The impression was given not that their names appeared in Debrett but rather that the industry was controlled by a handful of extremely wealthy individuals. That was far from the case, however, even in those days. The current position, according to this pamphlet, is that "Half the companies have more shareholders than employees. Nine out of ten shareholders own less than 500 shares each, and the ten largest shareholders own together an average of only 11½ per cent. of the total capital." The ten largest shareholders are not individuals but insurance companies, the Church Commissioners and the like.

Brazilian Bulletin, Vol. VIII, No. 49. Published by the Brazilian Government Trade Bureau in Great Britain, 157-161, Regent Street, London, W.1.

In this issue, which opens with a prophesy of increased trading in the near future, is an eight-page supplement of a statistical nature. The glossy-magazine section—covering 40-odd pages—of the bulletin shows the great potentialities of this truly vast country, but much depends upon more and better means of transport from the interior to the coast, and the provision of electric power-stations. It would seem worth while for firms attempting to do business with Brazil to study the essentially readable supplement. The British, according to the Brazilian viewpoint, have placed too much weight on the money owing from past transactions instead of banking on the great potential wealth of the country. Obviously there are two sides to such questions.

Dominican Republic—An Overseas Economic Survey, compiled by T. C. Ravensdale, C.M.G. Published for the Board of Trade by Her Majesty's Stationery Office, York House, Kingsway, London, W.C.2; price 2s. 3d. net.

There does not appear from this report to be much of a market for foundry products in the Dominican Republic. Referring to iron and steel manufactures and hardware it is stated that "the United Kingdom's lowly position in comparison with those countries (United States, Germany, France, Belgium) is partly attributable to inability so far to compete effectively in respect to delivery dates." Tables show that, overall, the United Kingdom has steadily been losing ground in these fields since 1952, sewing machines show a deplorable loss, though materials made from tin, lead, zinc, show a promising gain.

Pig-iron and Steel Production

Statistical Summary of June Returns

The following particulars of pig-iron and steel produced in Great Britain are from statistics issued by the British Iron and Steel Federation. Table I summarizes activities during the past six months. Table II gives production of steel ingots and castings in June and Table III, weekly average production of finished steel. Table IV gives the production of pig-iron and ferro-alloys in June, and furnaces in blast. (All figures are weekly averages in thousands of tons.)

TABLE I.—*Iron and Steel Price Index and General Summary of Pig-iron and Steel Production.*

Period.	B.o.T. Price Index, 1938 = 100.			Iron-ore output.	Imptd. ore used.	Coke to blast-furnaces.	Pig-iron, ferro-alloys prod.	Scrap used in steel prod.	Steel (incl. alloy).			
	I. & S.	Coal.	Basic materials excl. fuels[1]						Imports.[2]	Prod. ingots, castings.	Delivrs. finished steel.	Stocks.[3]
1955	276	399	529	311	244	246	240	213	29	381	305	1,247
1956	295	454	542	312	272	264	253	216	27	397	318	1,444
1957—Jan.[4] ..	317	475	558	346	273	267	257	224	13	416	322	1,391
Feb. ..	317	476	554	347	281	266	268	234	17	432	341	1,347
Mch. ..	317	477	552	343	298	270	277	228	17	431	336	1,358
April ..	317	477	555	329	301	273	277	223	12	430	317	1,438
May[4] ..	318	465	554	341	310	272	284	234	13	443	340	1,437
June ..	317	466	541	322	302	274	275	222	14	419	—	1,483

TABLE II.—*Weekly Average Production of Steel Ingots and Castings in* June, 1957

District.	Open-hearth.		Bessemer.	Electric.	All other.	Total.		Total ingots and castings.
	Acid.	Basic.				Ingots.	Castings.	
Derby, Leics., Notts., Northants, Essex	—	4.2	11.8 (basic)	2.6	0.1	17.2	1.5	18.7
Lancs. (excl. N.W. Coast), Denbigh, Flints., Cheshire	1.6	33.3	—	2.4	0.4	36.4	1.3	37.7
Yorkshire (excl. N.E. Coast and Sheffield) ..								
Lincolnshire	—	43.4	—	—	0.1	43.3	0.2	43.5
North-East Coast	1.0	80.2	—	1.5	0.4	81.1	2.0	83.1
Scotland	2.1	46.7	—	2.7	0.4	49.5	2.4	51.9
Staffs., Shrops., Worcs., Warwick.	—	19.9	—	1.3	0.7	20.0	1.9	21.9
S. Wales and Monmouthshire	3.8	86.9	7.5 (basic)	1.0	0.2	98.8	0.6	99.4
Sheffield (incl. small quantity in Manchester) ..	9.2	34.2	—	11.3	0.4	53.1	2.0	55.1
North-West Coast	0.1	1.7	5.0 (acid)	0.5	0.1	7.2	0.2	7.4
Total	17.8	350.5	24.3	23.3	2.8	406.6	12.1	418.7
May, 1957[4]	21.1	367.7	26.4	25.1	2.9	430.7	12.5	443.2
June, 1956	20.8	310.2	21.2	24.5	3.0	367.0	12.7	379.7

TABLE III.—*Production of New Non-alloy and Alloy Finished Steel.*

Product.	1955.	1956.	1956.	1957.	
			May.[4]	April.	May.[4]
Non-alloy steel:					
Ingots, blooms, billets and slabs[5]	4.9	4.7	4.8	4.5	5.7
Heavy rails ..	9.4	9.7	9.8	11.2	13.3
Sleepers, ..	2.0	1.8	1.8	2.6	2.6
Plates, ⅜ in. to ½ in.	46.1	50.2	49.3	53.5	58.7
Other heavy prod.	47.8	50.3	53.2	55.3	56.8
Ferro-concrete bars and rods ..	7.0	7.8	7.0	9.0	8.7
Wire rods ..	22.2	22.9	24.0	20.6	24.3
Arches, etc. ..	9.6	10.1	10.5	11.6	11.5
Other light sections	36.8	41.4	40.9	37.6	42.4
Bright steel bars ..	7.8	8.0	7.9	6.7	7.6
Hot-rolled strip ..	24.1	24.5	25.2	22.9	22.8
Cold-rolled strip ..	8.1	7.5	7.8	6.5	7.4
Sheets, incl. coated:					
(i) Hot rolled ..	16.6	15.0	14.5	11.9	12.9
(ii) Cold reduced	26.1	24.8	24.6	27.0	31.2
Tin and terneplate	15.6	15.9	16.4	21.3	22.2
Blackplate	1.4	1.3	1.4	0.9	0.9
Steel tubes, pipes ..	22.9	26.2	27.4	25.8	25.7
Tube, pipe fits. ..	0.4	0.5	0.4	0.5	0.5
Tyres, wheels, axles	4.8	4.6	4.6	4.5	5.6
Forgings (excl. drop forgings) ..	2.5	3.0	3.0	3.1	3.1
Steel castings ..	4.2	4.5	4.5	4.1	4.9
Tool, and magnet steel	0.3	0.3	0.3	0.3	0.4
Total	320.6	335.0	339.3	341.4	369.2
Alloy steel	15.8	17.3	17.8	16.2	19.1
Total deliveries from U.K. prod.[6] ..	336.4	352.3	357.1	357.6	388.3
Add: Imported finished steel ..	18.9	19.5	19.6	7.6	5.4
	355.3	371.8	376.7	365.2	393.7
Deduct: Intra-industry conversion[7] ..	50.9	55.2	57.0	49.5	54.9
Total new material ..	304.4	316.6	319.7	315.7	338.8

TABLE IV.—*Production of Pig-iron and Ferro-alloys during* June 1957

District.	Furnaces in blast.	Hematite.	Basic.	Foundry.	Forge.	Ferro-alloys.	Total.
Derby, Leics., Notts., Northants and Essex	25	1.7	27.4	18.7	0.6	—	48.4
Lancs. (excl. N.W. Coast), Denbigh., Flints, Cheshire	6	—	21.2	—	—	0.7	21.9
Yorkshire (excl. N.E. Coast and Sheffield) ..	—	—	—	—	—	—	—
Lincolnshire ..	9	—	37.2	—	—	—	37.2
North-East Coast	22	4.8	55.1	—	—	0.9	60.8
Scotland ..	9	0.9	15.9	1.3	—	—	18.1
Staffs., Shrops., Worcs. and Warwick ..	7	—	10.4	1.5	—	—	11.9
S. Wales and Monmouthshire	11	4.8	46.9	—	—	—	51.7
Sheffield	1	—	2.0	—	—	—	2.0
North-West Coast	9	20.7	—	0.3	—	1.6	22.6
Total ..	99	32.9	216.1	21.8	0.6	3.2	274.6
May, 1957[4] ..	101	30.6	226.8	23.4	0.5	2.2	283.5
June, 1956 ..	100	30.7	181.6	22.6	1.1	3.6	239.6

[1] Used in non-food manufacturing industry.
[2] Weekly average of calendar month.
[3] Stocks, mainly ingots and semi-finished, at the end of the years and months shown.
[4] Five weeks, all tables.
[5] Other than for conversion into any other form of finished steel listed.
[6] Includes finished steel produced in the U.K. from imported ingots and semi-finished steel.
[7] Material for conversion into other products also listed in this table.

News in Brief

FELCO HOISTS, LIMITED, London, S.W.7, has been appointed sole concessionaire for the sale of Templewood crane forks, with effect from October 1.

TO EXPLORE the possibilities of UK exports to China, Mr. F. J. Erroll, Parliamentary Secretary to the Board of Trade, is to spend three weeks in that country.

MACHINOIMPORT, the Russian trading organization in Moscow, has recently ordered two furnaces and an atmosphere generator from Birlec, Limited, for installation in the USSR.

THE Federation of Light Metal Smelters reports that its members' average selling prices for August, calculated to the nearest 10s., were:—LM1, £155 10s. per ton; LM2, £157; LM4, £181; LM6, £201 10s.

THE BRISTOL AND WEST OF ENGLAND BRANCH of the Institute of British Foundrymen comes of age on October 21; it having been first constituted as the Bristol section of the Wales and Monmouth branch.

A £30,000 ORDER for the supply of two 102-ton transformer wagons has been given to Head Wrightson Teesdale, Limited, Thornaby-on-Tees, by the Federation of Rhodesia and Nyasaland Power Board.

AN ORDER from an Italian shipyard valued at over £40,000 has been secured by Cockburns, Limited, Glasgow, to supply turbine-control valves for 21 tankers being built at the Cantieri Riuniti dell Adriatico Shipyard, Trieste.

THE COMBUSTION ENGINEERING ASSOCIATION is organizing a conference on "A Study in Detail of NIFES Third Progress Survey." It is being held on Tuesday and Wednesday, November 5 and 6, at the Old Swan Hotel, Harrogate.

MAGNET HOUSE, the new premises in Sheffield of the General Electric Company, Limited, was opened by the Lord Mayor recently. It was the anniversary of the opening of the company's first branch in Sheffield 50 years ago.

A GENERAL STAFF to supervise the expanded activity of the British Association for the Advancement of Science has been appointed following the gifts from industrialists of £40,000. This represents an income this year of £8,000.

FOLLOWING "The Way Ahead in RTB," a booklet dealing with education and training within the company, Richard Thomas & Baldwins, Limited, has published "Graduate Training in RTB," which deals in detail with the training of graduates who join the company.

BRIGHTON INDUSTRIES, LIMITED (one of the Ayling Industries Group of companies) has moved its headquarters from Portslade near Brighton to a new factory at Burgess Hill, Sussex, and has changed its name to Bribond, Limited. The new telephone number is Burgess Hill 85611.

G. W. B. FURNACES, LIMITED, Dudley (Worcs), has opened new London offices at Sicilian House, 7, Sicilian Avenue, W.C.1 (telephone: CHANCERY 6727). The sales engineers in London are:—Mr. D. H. Leage (electric furnaces); Mr. M. A. Stary (Powermaster boilers); Mr. K. Trudgen (control gear).

THE Treasury has made the Import Duties (Drawback) (No. 16) Order, 1957, which provides for the allowance of drawback of Customs duty paid on gas valves when water-heating appliances incorporating these valves are exported. The Order (SI 1957, No. 1639) came into operation on September 24.

DESPITE THE INFLUENZA EPIDEMIC, which has affected many northern industries, last Saturday well over 1,000 employees of Leyland Motors, Limited, visited London. Leaving Lancashire in the early hours of the morning on two special trains, they arrived at Euston at midday, reboarding the trains for the return journey just after midnight.

AT THE FORTHCOMING BUILDING EXHIBITION, which is to be held at Olympia from November 13 to 27, Thwaites Engineering Company Limited, Leamington Spa are organizing a sort of pools competition—the prize to be won is a £350 dumper. The entrance money so collected is to be handed over in its entirety to the British Empire Cancer Campaign.

IN THE PAST FEW MONTHS British Oxygen Linde, Limited, 160, Piccadilly, London. W.1, has received export orders for tonnage oxygen/nitrogen installations worth over £2,500,000. Other orders received by the company in this keenly competitive field, include two installations for the Shell group of companies in the UK which are due for completion early in 1958.

EXTENSIONS at the apprentice training school of the Metropolitan-Vickers Electrical Company, Limited, at Trafford Park, Manchester, were opened last week by Sir Edward Boyle, Parliamentary Secretary to the Ministry of Education. Sir Edward took the place of Lord Hailsham, who was unable to fulfil the engagement because of his new duties as Lord President of the Council.

DESCRIBED as being the worst for some 35 years, the floods in Chesterfield, on September 25, put 50 employees temporarily out of work at Hyde's iron and steel foundry, and 100 were engaged in clearing up. The steel foundry, the worst affected, had over 18 in. of water when the river Hipper overflowed, but the iron foundry, which is on a higher level, was not so seriously affected.

PLANS HAVE BEEN APPROVED for the erection of extensions to the Technical High School, Inverness, at an estimated cost of £91,160. The work, which includes a new assembly hall and nine additional classrooms, will be completed early in 1959. The school is the largest in the north, and the extensions will provide accommodation for an additional 300 students, bringing up the possible roll to 1,500.

AT the Corrosion Convention and Exhibition to be held at the Old Horticultural Hall, Westminster, S.W.1, from October 15 to 17, E. & F. Richardson, Limited, of Buckingham, will be showing on stands 50, 51 and 52, their newly-developed series of coatings for metal, based on neoprene (a synthetic rubber), claimed to be equally suitable for protection against 50 per cent. sulphuric acid or 50 per cent. caustic soda.

A. E. I. LAMP AND LIGHTING COMPANY, LIMITED, have announced an increase of 25 per cent. in the average life of Mazda mercury vapour discharge lamps (type MBF/U). Average lumen output is now maintained for 5,000 hours instead of 4,000 hours and prices remain the same. This increase will effect considerable savings in the unit cost of light from these lamps which range from 80- to 400-w. and are used principally for street and industrial lighting.

G. L. WILLAN, LIMITED, Sussex Street, Sheffield, who have for several years been engaged in the supply of special ingots for remelting by precision casting foundries, have now acquired a 56 lb. high-frequency vacuum melting furnace from EFCO-Edwards Vaccum Metallurgical Company, Limited. The new plant is to be formally opened on October 3, by Sir

News in Brief

Frederick Pickworth, the Master Cutler and chairman of the English Steel Corporation, Limited.

EIGHT WORKS EMPLOYEES of Hadfields, Limited, Sheffield, with a total service of almost 300 years, retired on Friday, September 27. All but one were over 70. Mr. F. A. Bailey, local director of No. 1 machine shop, and Mr. H. C. T. Torrey, manager of the machine shop, presented seven of them with cheques for £20 to mark their retirement. Mr. J. Carter, a turner and carbide tool grinder, who is 75 and has been with the firm 42 years, could not be present through illness.

ENGLISH STEEL CORPORATION, LIMITED, Sheffield, have awarded scholarships this year to Alick Priest, Cedric Colley, Douglas Liversidge (research), and John Drewery (maintenance). The first three will study metallurgy at Sheffield University for a year. John Drewery will read for a mechanical engineering degree there for three years. Raymond Brook, a scholarship winner last year, will remain at Sheffield University for another year to study for a Master of Metallurgy degree.

VICKERS-ARMSTRONGS (TRACTORS), LIMITED, is taking over factory space in Scotswood Road, Newcastle-upon-Tyne, formerly occupied by Churchill Gear Machines, Limited. The extra space is required by Vickers-Armstrongs to meet an increased demand for tractors. The new factory for Churchill Gear Machines at Blaydon-on-Tyne were opened last Saturday by Lord Lawson, Lord Lieutenant of Durham. The former premises of the company were leased from Vickers-Armstrongs.

A DELEGATION organized by the British Productivity Council has left to study production methods in Germany. Sir Thomas Hutton, director of the Council, said they were going to see why the Germans were getting ahead so fast. It could not be just hard work. Getting out of the present economic jam was very largely a question for management, and although he believed this country had all the ingredients of efficiency, if there was one weakness it was in the management of production.

Mr. GEORGE HARRIMAN, deputy chairman and joint managing director of the British Motor Corporation, returned to this country on September 24 after a five-week tour in Australia and America. On his return to Longbridge he said that the Corporation had increased its share of British cars being exported to the USA to over 50 per cent. in the last month. Nearly 4,000 cars were being exported per working month to the USA by the BMC and Americans had now replaced the Australians as the Corporation's best customers.

A RANGE of portable, single -and two-stage rotary air-compressor plants and pneumatic tools will be shown by Broom & Wade, Limited, High Wycombe, on stands 309R, 316Q, in the National Hall, Olympia, during the Building Exhibition to be held from November 13 to 27. The portable range will include a new single-stage rotary air-compressor designed to deliver 45 cub. ft. of free air per min. at 100 lb. per sq. in. pressure, and among the pneumatic tools the new "Aro Broomwade" lightweight hoist will be featured.

AN EXHIBITION OF PHOTOGRAPHS will be on show at Kodak House, Kingsway, London, W.C.2, from October 16 to November 2. Entitled "Photography in the Service of the Nation," this exhibition comprises a collection of photographs by H.M. Government photographers, showing the many different types of work carried out by Government departments. The exhibition will be opened at a private view by Dr. The Rt. Hon. Charles Hill, M.P., the Chancellor of the Duchy of Lancaster, who is responsible for the co-ordination of Government information services.

SAMUEL OSBORN & COMPANY, LIMITED, are widening their scheme by which overseas students have an opportunity of working inside their steel plant and learning Sheffield techniques. Students may apply to the company's agents in other countries to train in a British works and these are passed on to the Sheffield office. The scheme operated before the war and has been gradually introduced again since, with most students coming from the Commonwealth. Negotiations are now going on for students from Spain and India. They come to the firm for periods ranging from three months to three years.

Sir PETER ROBERTS, the Master Cutler, and Lady Roberts, gave an "At Home" at the Cutlers' Hall, Sheffield, on Friday, September 27, to 600 guests including two coachloads from Sir Peter's estate at Cockley Clay Hall, Swaffham, Norfolk. The retiring Master Cutler described the occasion as a "farewell and thank-you party" for those they had met and who had helped them during their year of office. Guests included 80 from the Thorncliffe Works of Newton Chambers & Company, Limited, of which Sir Peter is chairman, and members of the staff of Wombwell Coking and By-Products, Limited.

THE PRESIDENT AND MEMBERS of the Council of the Manchester Association of Engineers will be attending morning service at Manchester Cathedral on Sunday October 6, at 10.30 a.m. In view of the response on the similar occasion last year, the president hopes that he will be accompanied by many members. At the opening meeting of the 1957/58 session, to be held at the Engineers' Club, Albert Square, Manchester 2, on October 11, at 6.30 p.m., the agenda will include, the induction of the president, Professor F. C. Thompson, M.SC., D.MET. who will deliver his inaugural address, and a smoking concert.

ACCORDING to *Overseas Review* issued by Barclays Bank, Northern Rhodesia may have one of the most extensive deposits of niobium (columbium) in the world. The metal, which is extracted from pyrochlore and is valued as an alloying material in metallurgy, has been discovered in more than normal richness in the Feira area. The review also reports that two new deposits of pyrochlore have been discovered in the Southern Province of Nyasaland by the Geological Survey Deparement. The new deposits are both situated near Zomba and further investigations are being carried out.

Foundry Equipment Business

Mr. J. G. W. Lowe, managing director, Sterling Foundry Specialties, Limited, points out that in the report entitled "Foundry Equipment Business," published in the JOURNAL, September 12, p.308, it was misleading to omit mention of moulding boxes when reporting the statistics for the second quarter of this year. Actually, the figures of £78,000 value for export orders and £284,000 for other orders in that period embrace both moulding machines and moulding boxes and not merely moulding machines. Mr. Lowe supplies the additional information that over one-third of the total is accounted for by moulding boxes. Apologies for the omission are made to readers and to moulding-box manufacturers. The latter are to be congratulated on such a high turnover, particularly in the export market.

Personal

Mr. J. YOUNG is to resign from the board of G. & J. Weir, Limited, engineers, Glasgow.

Miss L. A. PITTOM, is to succeed Mr. F. W. TAYLOR as factory inspector in charge of the Birmingham West district.

Mr. GILBERT A. DURANT has been appointed works director of the Revo Electric Company, Limited, with effect from October 1.

Mr. W. J. PLANT, an 84-year-old retired iron moulder, has received the gold medal of merit for 55 years' service in the National Union of General & Municipal Workers.

Aluminium Union, Limited, announce that Mr. GEORGE T. FIELD, formerly of the Board of Trade, has been appointed to an executive position at their London office.

Steel Peech & Tozer, a branch of United Steel Companies, Limited, has appointed Mr. J. TAYLOR sales manager of the hot-strip rolling mills, Mr. I. MULHEARN sales manager of the cold-strip rolling mills and Mr. P. SHERWELL manager of the central sales office.

Mr. CHARLES DAWSON MACMILLAN, head of the department of mechanical production and civil engineering at Rotherham College of Technology, has been appointed principal of Keighley Technical College and School of Art. He is expected to take up the post on January 1.

Two student apprentices at David Brown factories at Huddersfield, Mr. ROBERT IRVING and Mr. DAVID MITCHELL, both 21 years old, have been awarded technical State scholarships. Both have been part-time students at the mechanical engineering department of Huddersfield Technical College.

Metropolitan-Vickers Electrical Company, Limited, announces the appointment of Dr. J. F. SHANNON as chief engineer, gear engineering department. Dr. W. H. DARLINGTON relinquishes the title of chief engineer, gas turbine and gear engineering departments and is now chief engineer, gas turbine engineering department.

Mr. HORACE W. POCHIN, chairman and managing director of the Standard Engineering Company, Limited, Leicester, has on medical advice resigned the managing directorship of the company. He will continue as chairman of the Standard group of companies. He will be succeeded by Mr. R. PADDY SWAIN, who joined the firm in 1928.

Mr. W. E. OGDEN and Mr. W. W. DOLTON, chairman and managing director respectively of the Delta Metal Company, Limited, have been appointed directors of James Booth & Company, Limited, and its subsidiary John Wilkes Sons & Mapplebeck, Limited. This follows the recent acquisition of James Booth & Company, by the Delta Metal Company.

Mr. A. G. STEWART, chairman and general managing director of Stewarts and Lloyds, Limited, has resigned from the board of Stanton Ironworks Company, Limited, and will be succeeded as chairman by Sir FREDERICK SCOPES. Sir Frederick will be succeeded as managing director of Stanton by Mr. N. C. MACDIARMID, at present assistant managing director.

Mr. A. J. SPEAKMAN has resigned as deputy director of the British Productivity Council. He joined the Council soon after its formation in 1953 as technical officer, later became head of the work-study unit and was made deputy director last year. Mr. Speakman is joining the United Steel Companies, Limited, as a member of its department of operational research and cybernetics.

Mr. A. M. TAYLOR, M.A., F.C.I.S., secretary and commercial manager of Foster Transformers, Limited, Wimbledon, has been appointed a director of the company. Mr. Taylor, who joined the Lancashire Dynamo organization in 1948, has been commercial manager of the Foster company since that time, becoming secretary in 1953; he is also secretary of Foster Electrical Supplies, Limited.

Dr. E. S. HEDGES, director of the International Tin Research Council, left London by air last Saturday for a month's coast-to-coast tour of Canada. He will visit the headquarters of the National Research Council of Canada in Ottawa and the Council's provincial centres in Manitoba, Saskatchewan, Alberta and British Columbia. On his return through the United States, Dr. Hedges will visit the Tin Research Institute's office in Columbus, Ohio.

On September 18, Mrs. EMMA JANE LAKINS, of Quinton, Birmingham, had her 85th birthday, but those people who called on her to wish her well found she was at work. Mrs. Lakins puts in a 44-hour week, spread over five days at the Salford Bridge brassfoundry of James Collins (Birmingham), Limited. Mr. E. V. Castro, managing director, said that when the firm moved a little further from the centre of the city it was suggested to this aged lady that she might not come in so early, but she felt insulted.

Mr. E. R. L. LEWIS has been appointed to the newly-created post of controller of education for the English Electric group of companies. He will be responsible for the development of education and training throughout the group. In addition to his duties with the company, Mr. Lewis serves on a number of educational committees and is a governor of the Mid-Essex Technical College at Chelmsford. Sir RONALD NESBITT-HAWES has been appointed education adviser to the group and Mr. W. R. AHERN becomes chief technical personnel officer.

Mr. SYDNEY S. GUY, who founded Guy Motors, Limited, of Wolverhampton, 43 years ago, has announced his retirement as chairman and managing director of the company and its associate, the Sunbeam Trolleybus Company, Limited. Aged 72, he is the last pioneer commercial-vehicle manufacturer personally to have directed the company to which he gave his name. After studying at Birmingham Technical College, Mr. Guy served an apprenticeship with Belliss & Morcom, Limited, the Birmingham engineers. Subsequently he went to the General Electric Company, Limited, and then as service manager of Humber, Limited, before he was appointed works manager of the former Sunbeam Motor Car Company, Limited, Wolverhampton, in 1908 at the age of 24. He left the Sunbeam company and formed Guy Motors, Limited, in 1914.

Obituary

Mr. ALFRED TEMPLEMAN RILEY, who died last Friday, was formerly outside engineering manager of Alexander Stephen & Sons, Limited, ship builders and repairers, of Linthouse, Glasgow.

The death has occurred at the age of 61 of Mr. ALEXANDER KARI, managing director of the Unislip Propeller Company, Limited, Newcastle-upon-Tyne, and an official of the North Eastern Marine Engineering Company, Limited, Wallsend. Mr. Kari, who was formerly on the design staff of Vickers-Armstrongs, Limited, was an authority on propellers and ship propulsion, and was the inventor of the Unislip propeller.

Raw Material Markets

Iron and Steel

A high level of output of pig-iron is maintained and tonnages available for distribution exceed all previous figures. Although the number of furnaces now in blast is smaller, average production from the new and larger rebuilt units exceeds the target for the year of 14,000,000 tons. Additional quantities will be forthcoming when other furnaces now in course of construction are brought into operation. Home supplies are now available in sufficient quantities to satisfy all demands.

Basic steelmaking pig-iron continues to comprise about 80 per cent. of total output, most of which is being absorbed by the steelworks whose requirements now appear to be fully met. Consignments from abroad are being placed into stock and are expected to diminish as contracts are completed. There are ample supplies of foundry pig-iron, and, apart from some brands of the low-phosphorus irons, makers have excess tonnages available in all grades after satisfying current demands. The engineering foundries producing high-duty castings are still the most favourably employed, and accordingly the call for low-phosphorus pig-iron and hematite is greater. Many of the trades for which they cater are taking up appreciable quantities of castings and there is a good level of production for which large quantities of pig-iron are required.

The effect of the new anti-inflation measures on the foundry industry cannot at present be assessed, but production is expected to slow down and this would in turn affect adversely the demand for castings. In the case of the light foundries, particularly those catering for the building and domestic equipment trades, the future is not very bright. Many of these, together with the textile and some of the jobbing foundries, are short of work and the call for high-phosphorus pig-iron continues moderate. There is very little forward buying, as deliveries can be obtained promptly to satisfy consumption requirements, and under present conditions the foundries do not feel disposed to carry stocks.

The foundries have fairly good supplies of scrap, the chief call being for heavy cast-iron and machinery scrap. Light and medium grades are plentiful. Foundry coke is also available in adequate quantities, although some of the Welsh grades are in short supply. Ganister, limestone, and firebricks are available on demand.

The increase in the supply of billets from home steelworks is proving adequate for many of the re-rollers and they can undertake promptly the orders on hand for small bars, light sections, etc., and accept additional work when this can be obtained. Orders, however, for small bars and light sections are not so plentiful and some re-rolling mills in the English Midlands are not fully employed. More business for billets could be undertaken by home steelworks, but some re-rollers have good stocks which they do not wish to increase for economic reasons, and they are refusing to accept additional supplies, particularly in the smaller billet sizes, from either home sources or abroad.

Re-rollers of sheets have fairly good order-books, and those supplying reinforcing rods are covered for their output from some months ahead.

Non-ferrous Metals

Trading in all the non-ferrous metals has been on quiet lines this week. Consumers are in no way anxious buyers. Their needs at the moment are not spectacular, and while with prices at present levels they are perhaps not over anxious to work down their stocks, they are certainly not keen to expand them at current interest charges.

In tin, prompt supplies have not been overplentiful and for a time there was a technical squeeze which resulted in a sizable backwardation towards the end of last week. This has now been narrowed. News that the Steel Company of Wales has had to cut back its production of tinplate is an adverse factor from the tin consumption point of view. On the other hand, more buying interest from the Continent is reported.

Conditions in the copper market are still uncertain. There are no fresh factors promising support to the market, but with the quotation below £200 there would probably be a quick response to any favourable development.

Depressed markets are to be seen still in lead and zinc. News that an application seeking 50 per cent. higher tariffs on lead and zinc imports had been filed with the US Tariff Commission had been anticipated and had little reaction on the market.

Iron-ore Imports

Iron-ore imports in August, and the totals for the first eight months of this year and last, are shown below.

From	Month ended Aug. 31.	Eight months ended August 31.	
	1957.	1956.	1957.
	Tons.	Tons.	Tons.
Sierra Leone	72,410	448,937	505,671
Canada	554,859	1,427,964	1,753,641
Other Commonwealth countries and Eire	4,280	12,125	13,682
Sweden	423,815	2,946,433	2,686,279
Norway	33,472	59,404	167,479
Western Germany	—	3,008	17
France	47,823	435,796	418,292
Portugal	13,150	80,612	92,746
Spain	113,786	592,150	760,669
Algeria	156,566	1,040,885	1,009,231
French West Africa	56,861	432,333	442,717
Tunisia	11,350	509,228	479,251
Northern Morocco	26,900	193,184	171,417
Southern Morocco	35,564	288,046	254,417
Liberia	35,940	239,164	253,598
Brazil	78,202	369,955	465,239
Other foreign countries	103,621	506,726	823,610
TOTAL	1,768,599	9,585,950	10,297,956

Increases in Capital

BASON & SONS, LIMITED, engineers, etc., of Stockport, increased by £9,000, in £1 ordinary shares, beyond the registered capital of £1,000.

A. A. BRAMELL, LIMITED, sheet metal workers, etc., of Stapleford (Notts), increased by £9,900, in £1 ordinary shares, beyond the registered capital of £100.

HENRY SQUIRE & SONS, LIMITED, lock manufacturers, etc., of Willenhall (Staffs), increased by £10,000, in £1 ordinary shares, beyond the registered capital of £10,000.

FLUOR ENGINEERING & CONSTRUCTION COMPANY, LIMITED, 79-80, Cornhill, London, E.C.3, increased by £9,900, in £1 ordinary shares, beyond the registered capital of £100.

SEALEY ENGINEERING COMPANY, LIMITED, precision engineers, etc., of London, S.W.19, increased by £7,000, in £1 ordinary shares, beyond the registered capital of £3,000.

SOUTH BIRMINGHAM JIG & TOOL COMPANY, LIMITED, 333, Yardley Wood Road, Moseley, Birmingham, increased by £3,000, in £1 ordinary shares, beyond the registered capital of £5,000.

MITCHAM MANUFACTURING COMPANY, LIMITED, manufacturers of knitting machines, etc., of London, N.W.10, increased by £9,900, in 6,900 "A" and 3,000 "B" shares of £1 each, beyond the registered capital of £100.

C. E. JOHANSSON, LIMITED, manufacturers of gauges, precision tools, etc., of Southfields Road, Dunstable, increased by £50,000, in £1 ordinary shares, beyond the registered capital of £100,000.

Forthcoming Events

Institute of British Foundrymen

OCTOBER 4

West Wales section: "Aids to Production in a Jobbing Foundry," by Ivor Rees and D. H. Snelson, 7 p.m., in the canteen of the Glanmor Foundry Company, Limited, Llanelly.

OCTOBER 5

Wales & Monmouth branch: "Aids to Production in a Jobbing Foundry," by Ivor Rees and D. H. Snelson, 6 p.m., at the Engineers' Institute, Cardiff.

OCTOBER 7

Institution of Works Managers

Tyne-Wear branch: "Industrial Engineering," by C. Fitton, 6.30 p.m., in the Conference Room, Ministry of Labour and National Service, 93a, Grey Street, Newcastle-upon-Tyne.

OCTOBER 8

Institute of British Foundrymen

Sheffield and district branch: Presidential address by G. L. Hancock, followed by dinner at the Sheffield and Ecclesall Co-operative Society, Limited, Ecclesall Road, Sheffield.
Slough section: "The Know-how of the CO_2 Process"—Brains Trust, with D. V. Atterton, J. L. Rice, A. Talbot, and A. P. Lovat serving on the panel, 7.30 p.m., in the Lecture Theatre, High Duty Alloys, Limited.

Institution of Production Engineers

Oxford section: "Automation for Batch Production," by Ian Nickols, 7.30 p.m., at Aylesbury.

Institution of Works Managers

Birmingham branch: "Industrial Relations To-day," by Sir Frederick Leggatt, K.B.E., C.B., 7 p.m., at the Byng Kendrick Suite, New College, Birmingham College of Technology, Gosta Green.
Sheffield branch: Evening visit to the Metal Box Company, Limited, Sutton-in-Ashfield, near Mansfield. (Details from secretary.)

OCTOBER 9

Institution of Production Engineers

Liverpool section: "Design for Production," by W. Moore, 7.30 p.m., at the Exchange Hotel, Tithebarn Street.

Society of Chemical Industry

Corrosion group: "Corrosion-resistance of Titanium," by J. B. Cotton and H. Bradley, 6.30 p.m., at 14, Belgrave Square, London, S.W.1.

Institute of Fuel

One-day symposium on "Flames and Industry," 10.30 a.m. to 12.30 p.m., and 2.30 to 4.45 p.m., at the Institution of Civil Engineers, Great George Street, London, S.W.1.

Institute of British Foundrymen

OCTOBER 10

Beds/Herts section: Presidential evening, 7.30 p.m., at K & L Steelfounders and Engineers, Limited, Letchworth.

OCTOBER 11

Bristol and West of England branch: "Use of Epoxide Resins for Patternmaking," by J. F. Bowers, 7.30 p.m., at the Grand Hotel, Bristol.

OCTOBER 12

Lancashire branch: "Services for the Moulder," by H. Paton Millar, 3 p.m., at the Midland Hotel, Manchester.
Scottish branch: Presidential address by A. S. W. Sawers, followed by "Ultrasonic Inspection of Castings," by J. Jarvis, 3 p.m., at the Royal Technical College, George Street, Glasgow.

Mr. NORMAN HARVEY has been appointed development manager of the Aston Chain & Hook Company, Limited, non-ferrous metal engineers, of Erdington, Birmingham. He will be in charge of all research, development, and laboratory services, and his responsibilities will also embrace work and method study and labour incentive schemes. Formerly the company's chief metallurgist, Mr. Harvey took his M.Sc. degree after being seconded from the factory for 12 months while studying engineering production at the University of Birmingham.

Recent Wills

DRIFFIELD, E. H., late managing director of Ellerby Foundry, Limited, Leeds £37,715

PIERSON, H. C., of Altrincham (Ches), late director of the Metropolitan-Vickers Electrical Company, Limited £56,134

HULME, WALTER, managing director of Morrison, Ingram & Company, Limited, foundrymen and sanitary engineers, of Manchester £21,077

TANGYE, G. H., retired consultant engineer, of Tangyes, Limited, manufacturers of diesel engines, pumps, etc., of Smethwick £4,541

PEGLER, F. E., of Blyth, Worksop (Notts), late chairman of the Northern Rubber Company, Limited, and Peglers, Limited, brassfounders, etc., of Doncaster, personal estate in England, Scotland, and abroad £179,955

LEWIN, FRANK, manager of patents for the David Brown Corporation, Limited, Meltham, Huddersfield, and for almost 50 years conductor of a patent agency in Halifax and Huddersfield under the name of Baron & Lewin £7,840

HALL, F. A., founder and chairman and managing director of Ductile Steels, Limited, Willenhall, a director of A.P. Metalcraft, Limited, Shipston-on-Stour, Dyner Steel, Limited, Swansea, and interested in other companies £181,488

RAMBUSH, DR. N. E., inventor of gas-making machinery and an authority on gas production, chairman and managing director of the Power-Gas Corporation, Limited a director of the International Meehanite Metal Company, Limited, and other companies £23,700

THOMSON, THOMAS, a former director of John Miles & Partners (London), Limited, consulting engineers, previously chief engineer of the Appleby-Frodingham Steel Company (branch of the United Steel Companies, Limited) at Scunthorpe, and with H. A. Brassert & Company, Limited, as director and chief engineer, and was in charge of the reconstruction of the Irlam Works of the Lancashire Steel Corporation, Limited, the construction of the Corby Works of Stewarts and Lloyds, Limited, and the reconstruction of the Ebbw Vale Works of Richard Thomas & Company, Limited £26,827

Board Changes

ENGLISH TOOLS, LIMITED—Mr. Eric G. Parkes has been elected a director.

DAVY BRITISH OXYGEN, LIMITED—Dr. L. G. Groves has been appointed managing director and relinquishes his appointment on the board of British Oxygen Wimpey, Limited.

MONSANTO CHEMICALS, LIMITED—Mr. H. Driver, previously an alternate director, has been appointed a director. He will continue as secretary and head of the legal department, and will also be responsible for insurance.

SCOTTS' SHIPBUILDING & ENGINEERING COMPANY, LIMITED—Mr. George Hilton has been appointed managing director of the company. Last April he became deputy managing director, in addition to his position of shipbuilding director.

BRUSH GROUP, LIMITED—Sir Roy Dobson has been elected deputy chairman. He is chairman of the Hawker Siddeley Nuclear Power Company, managing director of A. V. Roe & Company, Limited, and a director of the Hawker Siddeley Group, Limited, High Duty Alloys, Limited, and other companies.

BRITISH GLUES & CHEMICALS, LIMITED—Mr. Harold J. Cotes, deputy chairman and managing director, has been appointed chairman. He succeeds Sir Roger Duncalfe, who has resigned as chairman and from the board on medical advice. Mr. D. R. Ashworth, who has been technical controller of the company since 1946, has been appointed a director.

Current Prices of Iron, Steel, and Non-ferrous Metals

(*Delivered unless otherwise stated*)

October 2, 1957

PIG-IRON

Foundry Iron.—No. 3 Iron, Class 2:—Middlesbrough, £21 6s. 0d.; Birmingham, £20 18s. 3d.

Low-phosphorus Iron.—Over 0.10 to 0.75 per cent. P, £23 17s. 0d., delivered Birmingham. Staffordshire blast-furnace low-phosphorus foundry iron (0.10 to 0.50 per cent. P, up to 3 per cent. Si), d/d within 60 miles of Stafford, £24 1s. 3d.

Scotch Iron.—No. 3 foundry, £25 3s. 6d., d/d Grangemouth.

Cylinder and Refined Irons.—North Zone, £25 19s. 0d.; South Zone, £26 1s. 6d.

Refined Malleable.—P, 0.10 per cent. max.—North Zone, £27 6s. 6d.; South Zone, £27 9s. 0d.

Hematite.—Si up to 2 per cent., S. & P. over 0.03 to 0.05 per cent.:—N.-E. of England (local iron), £25 6s. 6d.; Scotland (Scotch iron), Zone S. 1, £25 13s. 0d.; Sheffield, £26 15s. 0d.; Birmingham, £27 4s. 0d.; Wales (Welsh iron), £25 6s. 6d.

Basic Pig-iron.—£20 3s. 0d., delivered Staffs, Derbyshire, Notts, Lincs, Rutland, Northants, and Leics.

FERRO-ALLOYS

(*Per ton unless otherwise stated, delivered*)

Ferro-silicon (6-ton lots and over).—45 per cent. Si, £50 0s. 0d. to £52 15s. 0d., scale 17s. 0d. to 17s. 6d. per unit; 75 per cent. Si, £70 0s. 0d. to £76 7s. 6d., scale 17s. 0d. to 17s. 6d. per unit.

Ferro-vanadium.—50/60 per cent., 28s. 6d. per lb. of V.

Ferro-molybdenum.—65/70 per cent., carbon-free, 12s. 6d. per lb. of Mo.

Ferro-titanium.—20/25 per cent., 2-3 per cent. Cu, £250 0s. 0d.; 38/40 per cent., commercially carbon-free, £299 0s. 0d.

Ferro-tungsten.—80/85 per cent., 9s. 7d. per lb. of W.

Tungsten Metal Powder.—98/99 per cent., 12s. 7d. per lb. of W.

Ferro-chrome (6-ton lots and over).—4/6 per cent. C, £96 0s. 0d. to £99 10s. 0d., basis 60 per cent. Cr, scale 33s. 0d. per unit; over 6 per cent. C, £94 0s. 0d., basis 60 per cent. Cr, scale 31s. 0d. to 33s. 0d. per unit; 2 per cent. C,* 2s. 2d. per lb. Cr.; 1 per cent. C,* 2s. 2½d. per lb. Cr; 0.15 per cent. C,* 2s. 3d. to 2s. 3½d. per lb. Cr; 0.10 per cent. C,* 2s. 3½d. to 2s. 3¾d. per lb. Cr; 0.06 per cent. C,* 2s. 3¾d. to 2s. 4d. per lb. Cr.

Metallic Chromium.—98/99 per cent., 7s. 3d. to 7s. 10½d. per lb.

Metallic Manganese.—90/92 per cent., carbon-free, £290 0s. 0d.; 96/98 per cent., £310 0s. 0d.

Ferro-columbium.—65/75 per cent., Nb + Ta, 22s. 0d. to 23s. 0d. per lb., Nb + Ta.

Ferro-manganese (home).—78 per cent., £87 19s. 3d.

SEMI-FINISHED STEEL

Re-rolling Billets, Blooms, and Slabs.—Basic: Soft, u.t., £33 1s. 6d.; tested, 0.08 to 0.33 per cent. C, £34 1s. 6d.; hard (0.41 to 0.60 per cent. C), £35 3s. 0d.; silico-manganese, £44 2s. 6d.; free-cutting, £37 5s. 6d. Siemens Martin Acid: Up to 0.25 per cent. C, £41 7s. 0d.; silico-manganese, £44 10s. 0d.

Billets, Blooms, and Slabs for Forging and Stamping.—Basic, soft, up to 0.33 per cent. C, £38 16s. 0d.; basic, hard, over 0.41 up to 0.60 per cent. C, £39 18s. 6d.; acid, up to 0.25 per cent. C, £43 10s. 0d.

FINISHED STEEL

Heavy Plates and Sections.—Ship plates (N.-E. Coast), £42 12s. 0d.; boiler plates (N.-E. Coast), £45 2s. 0d.; floor plates (N.-E. Coast), £44 1s. 0d.; angles, N.-E. Coast, £40 6s. 6d.; joists, N.-E. Coast, £40 2s. 6d.

Small Bars, Sheets, etc.—Rounds and squares, under 3 in., and flats, 5 in. wide and under, untested soft basic, 50 tons and over, £40 8s. 0d. (under 10 tons to 4 tons, £41 5s. 6d.; under 4 tons to 2 tons, £41 10s. 6d.); hoop and strip, coils, £40 10s. 0d.; uncoated strip mill coils, hot rolled, under 3mm. to 12g., £45 16s. 0d.; black sheets (hand mill), 24 g., £59 4s. 6d.; galvanized corrugated sheets, 24 g., £68 17s. 0d.

Alloy Steel Bars.—1 in. dia. and up: Nickel, £69 9s. 6d., nickel-chrome, £100 12s. 6d.; nickel-chrome-molybdenum, £112 16s. 6d.

NON-FERROUS METALS

Copper.—Cash, £194 0s. 0d. to £194 10s. 0d.; three months, £197 0s. 0d. to £197 5s. 0d.; settlement, £194 10s. 0d.

Copper Tubes, etc.—Solid-drawn tubes, 1s. 10½d. per lb.; rods, 218s. 0d. per cwt. basis; 20 s.w.g., 251s. 3d. per cwt.

Tin.—Cash, £736 10s. 0d. to £737 0s. 0d.; three months, £735 10s. 0d. to £736 0s. 0d.; settlement, £737 0s. 0d.

Lead (Refined Pig).—First half October, £88 15s. 0d. to £89 0s. 0d.; first half January, £89 15s. 0d. to £90 0s. 0d.

Zinc.—First half October, £70 15s. 0d. to £71 0s. 0d.; first half January, £71 5s. 0d. to £71 10s. 0d.

Zinc Sheets, etc.—Sheets, 15g. and thicker, all English destinations, £106 5s. 0d.; rolled zinc (boiler plates), all English destinations, £104 0s. 0d.; zinc oxide (Red Seal), d/d buyers' premises, £85.

Brass Tubes, etc.—Solid-drawn tubes, 1s. 6½d. per lb.; sheets to 10 w.g., 168s. 0d. per cwt.; wire, 2s. 4¼d.; rolled metal, 168s. 0d. per cwt.

Brass (Brazing).—BS1400, B3 (65/35), £140; B6 (85/15), — ; BS249, —.

Brass (High Tensile).—BS1400, HTB1 (30 tons), £191; HTB2 (38 tons), — ; HTB3 (48 tons), — .

Gunmetal.—BS1400, LG2 (85/5/5/5), £173; LG3 (86/7/5/2), £184; G1 (88/10/2/½), £245; (88/10/2/1), £234.

Phosphor Bronze.—BS1400, PB1 (AID released), £250 per ton.

Phosphor Bronze Strip, etc.—Strip, 241s. 9d. per cwt.; sheets to 10 w.g., — per cwt.; wire, 3s. 7¾d. per lb.; rods, 2s. 11d.; tubes, 2s. 11d.; chill cast bars: solids 2s. 10¾d., cored 2s. 11¾d. (Charles Clifford, Limited.)

Nickel Silver, etc.—Rolled metal, 3 in. to 9 in. wide × 0.056, 3s. 6¼d. per lb.; round wire, 10g. in coils (10 per cent.), 3s. 11d.; special quality turning rod, 10 per cent., ½ in. dia., in straight lengths, 3s. 10d. All prices are net.

Other Metals.—Magnesium, ingots, 2s. 5½d. per lb. Antimony, English, 99 per cent., £210 0s. 0d. Quicksilver, ex-warehouse, £85 0s. 0d. Nickel, £600 0s. 0d. Aluminium ingots, £197 0s. 0d.; aluminium bronze (BS1400), AB1, — ; AB2, — .

* Average 68-70 per cent.